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EDITORIAL

THE reception accorded the first number of the JOURNAL has amply repaid the board of Editors for the time and labour spent in its preparation. We desire to thank the undergraduates and the staff for their whole-hearted coöperation with us in the successful inauguration of a monthly medical journal in this University. If interest and coöperation are sustained we can look forward to the day when the JOURNAL will be an institution of which the Faculty of Medicine will be proud and which, we hope, will carry far afield, without discredit, the name of the University of Toronto.

We are glad to present to you in this issue, following the substance of our editorial in the first number, two articles prepared by students of this faculty. Both have been admirably executed and great credit is due their authors. One, by a second year student no less, gives evidence of a long and painstaking search of anatomical history and embodies numerous instructive and highly entertaining anecdotes of that fundamental science. The other is an excellently prepared paper on a subject of considerable clinical interest, and should be carefully perused.

From outside the faculty we give you a republication of Lewis' classic. From the staff Professor Macleod contributes the first of a series of articles on the most recent advances in connection with insulin. Dr. Van Wyck presents a highly useful and concise summary of our present situation with regard to eclampsia, a subject in which he has done a great deal of very creditable work; and last but not least we have in this issue something from the pen of Colonel Lang, late head of the Department of Chemistry, which will well repay a reading.

IN every university a vast quantity of scientific research is being done yearly which seems useless to most undergraduates. We must not forget that there are many minor observations back of every advance made in scientific thought. Little did people think that the old fogey who classified mosquitoes was aiding in the great problems of wiping out yellow fever and malaria.

At the present time S. R. Detwiler of Harvard University is conducting some interesting experiments, the object of which is to discover the factors controlling the growth of nerve cells and fibres. He has been working with Amblystoma embryos such as are familiar to all medical students who have completed their embryological studies.

Some three years ago he showed that if the anterior limb rudiment, at a stage before the nerves had grown into it, was transplanted to a position a few segments back of its normal position, the dorsal root

ganglia (sensory) at the level of the transplanted limb became hyperplastic while the ganglia that would normally have supplied it did not develop to their usual size.

The motor cell centres in the brachial enlargement grew to the same extent whether the anterior limb was moved or not. Those in the region to which the limb was transplanted did not enlarge. By other experiments it was shown that if a more caudal portion of the embryonic spinal cord was transplanted into the brachial region, the motor areas of the transplanted piece developed to the same extent as the normal cord of that region would have developed.

In his latest experiments, which are very soon to be published, the anterior limb level of the embryonic spinal cord was reversed. The motor areas of the interchanged third and fifth segments developed respectively to the same extent as the usual fifth and third segments.

From these and other similar experiments he concluded that:

1. The sensory nerve centres in the embryo develop in response to the functional needs at the periphery.

2. The motor nerve centres develop in response to the stimulus of connection with central longitudinal tracts which grow only to certain definite levels.

RECENT years have witnessed the passing of many who have contributed largely to the inheritance of medicine which to-day is ours. Sir Frederick Treves whose death occurred at Lausanne on December 7th was such a figure, one of the chosen few who in his generation shed a special lustre upon the art of medicine by his achievements and scientific attainments.

Born in 1853 of Dorset yeoman stock he graduated from the Medical School of London Hospital in 1874. He started in a general practice and then changed to hospital work, becoming assistant surgeon and demonstrator in physiology in the London Hospital. In 1880 he began to teach anatomy and three years later became head of this department. His work on surgical applied anatomy soon attracted notice. In 1885 he was Hunterian Professor of Anatomy in the Royal College of Surgeons and gave four lectures on the anatomy of the intestinal canal and peritoneum in man which were epoch making. Then followed years crowded with many interests and achievements. The best known surgeon in the nineties, he was also a voluminous writer, an impressive teacher, a great traveller, a leader in student movements. He achieved added fame through his successful operation on Edward VII on the eve of the Coronation, June 1902. He was interested in Army Medical organization and was consulting surgeon to the forces in the South African and in the recent war. He retired in 1908 at the zenith of his career.

Any review of Treve's work must concede to him a place in the history of the progress of surgery. Moynihan has divided the history of surgery into three epochs. The first and longest was dominated by the writings of Hippocrates and Galen. The second great era was ushered in by Morgagni and Hunter in which pathology and morbid processes were studied and described. Lister's work was the foundation for the third era, the age of combined research in which clinical observation, inductive and deductive processes of reasoning and experimental inquiry are linked together. In this period the work of Treves stands

out as of the utmost significance. He was one of the pioneers in the field of abdominal surgery and did timely work in applied surgical anatomy.

The key to his life is in a very special sense to be found in his own words, in the rectorial address given by him at Aberdeen University in 1908—"the real factors in success are health, serviceable knowledge, sympathy and honesty, industry being presupposed". Treves symbolizes the necessary versatility of the well equipped scientist of to-day. In Osler's words he is one "who adding probity to learning, sagacity and humanity reached the full stature of a Hippocratean physician".

WE urge members of the staff who have articles in the course of preparation for other periodicals (providing their publication in this JOURNAL would not jeopardize their acceptance elsewhere) to permit their appearance in this magazine. In addition to this, may we ask any member of the staff who has previously published papers which he considers would be of interest to the undergraduate to permit their republication?

THE ART OF MEDICINE

Sir Benjamin Brodie, the great British surgeon of the nineteenth century, more than any other surgeon of his time endeavoured to raise the standard of the profession, of which, in one of his lectures at St. George's Hospital, he speaks in these words:

"One business of education is to impart knowledge, but another, and still more important one, is to train the intellectual faculties. To acquire the habit of fixing your attention on the object before you; of observing for yourselves; of thinking and reasoning accurately; of distinguishing at once that which is important from that which is trivial; all this must be accomplished in the early part of life or it will not be accomplished at all; and the same remark is not less applicable to qualities of another order. Integrity and generosity of character; the disposition to sympathize with others; the power of commanding your own temper; of resisting your selfish instincts; and that self-respect, so important in every profession, but especially so in our own profession, which would prevent you from doing in secret what you would not do before all the world; these things are rarely acquired except by those who have been careful to scrutinize and regulate their own conduct in the very outset of their career. . . ."

"You must feel and act as a gentleman. I can find no words so expressive of what I mean as this. But let there be no misunderstanding as to who is to be regarded as a gentleman. . . . It is he who sympathizes with others, and is careful not to hurt their feelings even on trifling occasions; who, in little things as well as in great, assumes nothing which does not belong to him, and yet respects himself; this is the kind of gentleman which a medical practitioner should wish to be. Never pretend to know what cannot be known; make no promises which it is not probable that you will be able to fulfil; you will not satisfy everyone at the moment, for many require of our art that which our art can not bestow."

THE PHYSIOLOGICAL ACTION OF INSULIN

By J. J. R. Macleod
Professor of Physiology, and Assistant Dean of the Faculty of Medicine, University of Toronto

An account of the experiments of Banting and Best and of the later work in which Collip and others participated, leading to the isolation of insulin, will be given in another article in this journal. The present one refers to the properties and the physiological action of the hormone on normal animals.

Although there can be no doubt of the high therapeutic value of insulin in the treatment of many cases of diabetes its value as a new instrument for the investigation of other problems of metabolism than those relating to this disease is also high. It furnishes the physiologist with a new instrument for the investigation of the many problems connected with the chemical processes which go on in the body; with a key which may serve to unlock some of the numerous doors which stand in the way to an understanding of the mysteries of animal metabolism. Evidence for this belief is founded, among other things, on the striking effects of insulin on normal animals. When it is administered to rabbits, for example, the first effect is a very rapid lowering in the percentage of sugar of the blood and when this reaches a certain level symptoms of a peculiar nature supervene. These consist usually of violent convulsive seizures each lasting for a minute or so, and of a gradually increasing state of coma with a fall in body temperature, ending often in death from respiratory failure. Symptoms of a similar character occur also in other animals, including man, after large doses of insulin. There are often premonitory symptoms and in man these are extreme hunger, anxiety, tremulousness and, later, quickened pulse and sweating. In searching for the cause of these remarkable symptoms we were guided by the observation made two years previously by Mann and Magath that the somewhat similar symptoms which develop in dogs after removal of the liver are dependent on the lowering of blood sugar and can be relieved by injections of glucose. Could the symptoms following insulin be due to the same cause? We very soon found this to be the case, the evidence being, partly, that they usually supervene in normally fed animals when the blood sugar has fallen to about 0.045 per cent. and, partly, that they are removed immediately by the addition of glucose to the blood, either by administering this sugar subcutaneously or by causing it to be liberated in the body from glycogen as by the injection of adrenalin. It was found moreover that of all the sugars glucose alone has an immediate and lasting effect, even laevulose and galactose, which are its nearest neighbours, having only a slight and transitory action. The symptoms therefore are related to a reduction in the concentration of glucose in the blood and must be dependent upon the consequent lowering of free glucose in certain of the tissues, to a condition of glucatonia, we may call it. Why this should be associated with the development of symptoms which are evidently due to abnormal stimulation of the nerve centres that control muscular action is difficult to explain. It looks as if some toxic substance had developed, whose

formation is ordinarily prevented by the presence of free glucose, or it may be that a certain tension of free glucose is essential for the chemical interchanges that are associated with the physiological functioning of the cells, particularly those of the nerve centres. The close similarity of many of the symptoms with those observed in anoxaemia, suggests the possibility that interference with the processes of intracellular oxidation is really responsible for the symptoms, and this view is fortified by the fact that the arterial blood becomes venous in colour when the symptoms supervene (Olmsted and Logan). Whatever may be their immediate cause, the discovery that the symptoms are related to hypoglycaemia and can be antidoted by glucose proved to be of great practical importance, for it sounded a note of warning in the use of insulin on patients and it provided a certain remedy should similar symptoms supervene as a result. Possibly also it explains in part at least the cause for the toxic symptoms on account of which previous observers, such as Zuelzer, had been compelled to abandon their investigations of the value of extracts of pancreas in the treatment of diabetes in man.

Although the symptoms commonly occur in well-fed animals when the blood sugar is about 0.045 per cent. they may fail to be observed until a much lower level has been reached. This is particularly the case when a large dose of insulin is given at some considerable time after food. The liability of symptoms to occur at about 0.045 per cent. of blood sugar has served as a useful basis for measurement of the dosage of insulin, one unit being defined as the amount which can lower the blood sugar to the convulsive level of 0.045 per cent. within four hours in rabbits weighing about 2 kilogrammes. Since this "physiological" unit, as it is called, is said to be stronger than is necessary for certain clinical purposes it has been decided for the present to use as the "clinical" unit one that is one-third the above strength. This question of the physiological assay of insulin is receiving much attention at present.

These observations clearly pointed the way to the next problem, namely, the cause for the lowering of the blood sugar. At first it seemed as if this should soon be solved, for it had been found by Banting, Best and Collip that insulin not only causes glycogen to be deposited in the liver of diabetic animals when sugar is given but also causes the respiratory quotient to become raised in a manner to indicate that there is increased combustion of carbohydrate. It seemed likely that stimulation of the same processes in the normal animal under insulin must be responsible for the disappearance of glucose from the blood. But the experimental evidence goes to show that the mechanism of action is much more complex. Glycogen is certainly not formed, when insulin is given to normal animals (McCormick, O'Brien and E. C. Noble); indeed it is decreased in amount (Dudley and Marrian), and no certain evidence can be obtained from respiratory experiments that more active combustion of glucose is a necessary accompaniment of the lowering of blood sugar. The consumption of oxygen greatly increases in dogs preceding the onset of symptoms, and the respiratory quotient usually becomes somewhat raised (Dixon, Eadie and Pember) but in mice changes of an opposite character occur (Dudley, Laidlaw, Trevan and Boock) and in rabbits they are, at first, like those in dogs, though less marked, and, subsequently, like those in mice. The glucose which disappears is apparently neither oxidized to carbon

dioxide and water nor polymerized into glycogen. For the present the problem is unsolved, but we must not lose sight of the possibility that insulin changes both glucose and glycogen into some intermediary product which we fail to identify with our present methods of analysis either because it does not give the reducing reactions upon which the detection and estimation of sugars depend, or because it is not precipitated by alcohol after treatment with strong alkali, which is the characteristic property of glycogen. That such substances may exist in the tissues is indicated by the fact that it is impossible, after injecting large amounts of sugar into animals, to recover much more than one-half by chemical analysis of the entire body.

Whatever may be the nature of the mechanism by which the blood sugar becomes lowered there is no doubt that it acts in the tissues and not in the blood itself (Eadie and Macleod). Thus, the addition of insulin to blood incubated outside the body does not alter the rate at which the sugar disappears from it, and when the isolated heart is perfused with a suitable saline solution containing sugar the addition of insulin to the solution causes this to lose its sugar more rapidly (Hepburn and Latchford).

The hypoglycaemic effect of insulin lasts for a period which varies in different animals. In rabbits the blood sugar often begins to rise again in about an hour after the injection, but this depends very largely on the amount of glycogen which is stored in the liver. This becomes converted into glucose to replace that lost from the blood, so that well-fed animals show much quicker recovery and can withstand much larger doses of insulin without the development of symptoms, than those previously starved. This mobilization of the carbohydrate reserves would appear to depend on the transmission to the liver through its nerve supply of messages set up by the hypoglycaemic condition, for Burn has shown that if the nerve pathway (splanchnic) be blocked by the drug ergotamine, insulin causes, in well-fed animals, more profound a degree of hypoglycaemia than otherwise. The importance of the glycogen reserves in combating the hypoglycaemic effects of insulin warns us that we must be careful in giving it to diabetic patients in whom, as we have seen, these are abnormally low.[1]

Numerous other problems relating to the physiological action of insulin are being investigated but space will not permit of more than a brief allusion to one or two of them. One is its effect on hyperglycaemia due to other causes than removal of the pancreas. These include, administration of glucose either by mouth or parenterally exogenous hyperglycaemia we may call it—and increased production of glucose from the glycogen stores of the liver—endogenous hyperglycaemia. This increased break down of glycogen may be brought about by a variety of experimental conditions which are conveniently classified as nervous and asphyxial. Under the former category are included puncture of the floor of the fourth ventricle of the medulla and stimulation of the sympathetic nerve supply of the liver, either electrically or by the injection of adrenalin; and under the latter, besides the various

[1]This disposes once and for all of the suggestion that the hypoglycaemia is due to a shutting-down of the production of glucose from the liver, which is further confirmed by the observation of Mann and Magath that insulin has its usual hypoglycaemic effect after removal of the liver.

forms of asphyxia itself the effect of numerous drugs such as the anaesthetics. So far as it has been investigated insulin is capable of preventing the development of hyperglycaemia in all these conditions. Most attention has been paid to its effect on the hyperglycaemia due to adrenalin, partly because of the possibility that insulin may be assayed by determining the amount necessary to antidote a known amount of this other hormone, which itself can be accurately assayed, and partly because an investigation of the physiological antagonism between the two hormones may throw some light on the mechanism of the action of insulin. Let me give one example to illustrate. We have seen that insulin causes the glycogen stored in the liver to become less in amount, acting in this regard like adrenalin, although probably much less quickly. When insulin is given along with adrenalin however glycogen disappears from the liver much more slowly than with adrenalin alone, indicating that under certain conditions the pancreatic hormone arrests rather than stimulates the break down of glycogen (E. C. Noble, McCormick, O'Brien). When these two hormones are in excess in the body the one prevents the other from causing glycogen to disappear. Another curious result of a somewhat similar nature has been obtained by Burn with pituitrin, a hormone derived from the pituitary gland. When it is given along with adrenalin it prevents hyperglycaemia and when it is given with insulin it prevents hypoglycaemia. I have mentioned these results to indicate the very puzzling nature of the problem of the action of insulin and to show that this action may possibly be linked with that of other hormones in the animal.

Another interesting effect of insulin is on the peculiar form of experimental diabetes caused by the drug phloridzin. Glycosuria occurs without there being any increase in the blood sugar and the oxidation of carbohydrate becomes interfered with, as revealed by a failure of the respiratory quotient to respond to the ingestion of sugar. Now, it is significant, as S. U. Page has found, that when insulin is given along with sugar to dogs completely under the influence of phloridzin the respiratory quotient becomes decidedly raised and the glycosuria lessened.

Whatever the mechanism of the action of insulin may be it is important to bear in mind that the direction of its control of carbohydrate metabolism is apparently not the same in the diabetic, as in the normal animal, for in the former it causes increased formation of glycogen and greater combustion of glucose whereas in the latter it inhibits the former process, if not indeed exciting glycogenolysis, and it does not necessarily stimulate the combustion of glucose. Where there has been a deficiency of insulin for the physiological control of carbohydrate metabolism, as in the diabetic, its replacement, by injection, causes those intermediary products of carbohydrate metabolism which have accumulated in the body because of its absence, to be immediately transformed. Insulin oils the halting machinery of carbohydrate metabolism in diabetes and allows it to run smoothly again, but it interferes with the action of this machinery when it is given to a normal animal in whom there is already a sufficient supply of insulin for all physiological purposes.

Little is as yet known regarding the chemical nature of insulin. Many of its reactions are similar to those given by proteose, an early

digestive product of protein. This probably explains why it is so readily destroyed by the ferments of the pancreas and stomach and cannot be successfully given by mouth. In the purest preparation from ox pancreas all of the characteristic colour reactions of protein are absent except the biuret reaction. It contains no phosphorus or carbohydrate, but a large percentage of sulphur. This would seem to indicate that it must be some low form of protein, although it is possible that it may not belong to this class of bodies at all but be some simpler substance with protein derivatives attached to it as impurities. In this connection it is significant that very active insulin has been prepared from the pancreas of the skate in which the biuret test could not be obtained. With regard to its solubilities, upon which of course its isolation depends, neutral alcohol up to about 80 per cent., dissolves it, so also does water but it is precipitated in very weak acid (P_H 4-6) and in the presence of high concentrations of neutral salts. It is also precipitated by such reagents as picric and benzoic acids, and it forms a salt with hydrochloric acid. The Collip process for its isolation in a state of sufficient purity for clinical use depends on dissolving it out of the macerated pancreas by weak (60 per cent.) alcohol, evaporating the extract to small bulk in vacuo, removing foreign proteins by stronger alcohol (80 per cent.) and fats by centrifuging or by ether and finally precipitating the insulin by increasing the alcohol to 90-92 per cent. Further purification can then be effected by reprecipitating, either by very weak acid (Shaffer-Doisy method) or by means of picric acid (Dudley method). In faintly acid reaction it withstands heat, for example such a solution can be continuously boiled for over an hour without perceptible deterioration, but in faintly alkaline reaction heat soon destroys it. It does not dialyse in faintly acid solution in which also it is readily adsorbed by charcoal and kaolin. These facts are sufficient to show that insulin is a substance of complex chemical structure which indicates that its isolation in a chemically pure state will be a matter of great difficulty. Its preparation by synthetic means is therefore at present out of the question.

Finally, a word concerning the insulin-like substances which have been prepared by Collip's process from numerous sources such as yeast and fungi. Most of these differ from insulin prepared from the pancreas of mammals or from the principal islets of the bony fishes in that they only slowly reduce the blood sugar, indeed this effect may be delayed for a day or so. The possibility therefore exists that they merely act by stimulating the production of insulin from the pancreas and if this be the case they can scarcely be of much value in the treatment of diabetes.

THE TREATMENT OF ECLAMPTIC TOXAEMIA

H. B. Van Wyck
Demonstrator in Obstetrics and Gynaecology

The treatment of any pathological condition, the nature and cause of which is not clearly understood must necessarily present a variety of details, each of which becomes a matter of controversy with the constantly new phases of experimental research; and, until a foundation of accurate pathology is attained the treatment of eclamptic toxaemia remains in its essentials empiric, the fruit of clinical experience rather than the deduction of proven experiment. Hence it is not surprising to find that while there are certain important factors of treatment agreed on by all authorities, there is the widest variation of opinion concerning other means of treatment of a disease, to explain the course of which so many hypotheses have been advanced. Each of the many investigations, the majority of which have resulted in little positive advance, has provided a corresponding number of suggestions for treatment; and this has produced a wealth of therapeutic measures, the large number of which in itself would seem to indicate their comparative inadequacy. Out of this therapeutic maze, however, the physician, who has to treat these exacting cases, has certain facts at his disposal which would appear to be no longer controversial, and which, although based on empirical grounds, form the most satisfactory rationale for treatment available until experimental research shall have provided a specific therapy.

Perhaps, most important of all is the conception which now prevails that the best treatment of eclampsia is the prevention of eclampsia. This is usually taken to mean that, when the symptoms of pre-eclamptic toxaemia appear, appropriate treatment should be directed to preventing the onset of convulsions. However, better still would it be, if possible, to so regulate the life, diet, habits and hygiene of the pregnant patient in the early months that the onset of the pre-eclamptic symptoms themselves would be prevented. This would constitute a prophylactic ideal to be striven for and should be considered as an important part of the treatment of normal pregnancy.

The subject may then be divided into a consideration of:

I. *Prophylactic treatment of the normal pregnant patient.*

II. *Treatment of pre-eclampsia.*

III. *Treatment of eclampsia.*

I. *Prophylaxis.*—The physician's advice and control of his patient should aim at keeping the normal patient normal. It is not intended here to give the details of the management of pregnancy. For the most part, these are matters of obvious common sense, but the regulation of rest, exercise, habits, dress, bathing, the prohibition of exposure to wet and cold, over strenuous exercise and fatigue are part of the attendant's duties. Most relevant to the potential danger of pre-eclampsia is the control of the diet, the relief of constipation, the treatment of focal infection, and the prescribing of rest.

A properly balanced diet for the normal healthy pregnant woman should not contain highly seasoned or indigestible articles of food. Meat only once a day and only four ounces in amount is advisable. During the last two months of pregnancy, meat may be prohibited and chicken and fish substituted.

Throughout the whole period of pregnancy, the staple of diet should be fruit, cereals, and vegetables, including a daily portion of the fresh salad vegetables, lettuce, celery, tomatoes, etc. The normal patient should be instructed to take six or eight extra glasses of water daily apart from what is usual at the meals.

To control the frequent tendency to constipation, dietary aids such as the bran cereals and bread stuffs, brown bread and fruit are more rational than drugs and usually more effective. Liquid paraffin or agar is useful.

If there is evidence of focal infection, it should be thoroughly and promptly treated. Most frequent are those cases requiring dental attention, and while the relation of a septic dental focus to pregnancy toxaemia is still a matter of controversy, the treatment of the sepsis is a sound prophylactic procedure.

The enforcement of rest periods during the day and of early hours of retiring at night is incumbent on the physician as the pregnant patient requires more rest than she usually feels inclined to take; and valuable as rest is in an established condition of pre-eclamptic toxaemia, perhaps more efficacious is it in maintaining normalcy.

Success in the management of pregnancy is to be attained only by careful and constant attention to detail; and although the value of prophylaxis is impossible to estimate, the potential danger of perverted metabolism confronting each patient from the inception of pregnancy justifies all measures rationally undertaken to avert it.

II. *Pre-eclamptic toxaemia.*—Here the most important point is early diagnosis because the earlier the treatment is undertaken in these cases, the more satisfactory will be the results. No cases prove so dangerous as those which have been neglected in the early stages. Early diagnosis of the toxaemic tendency depends on thorough pre-natal care and here one meets great divergence of opinion and practice. Adequate frequency of urine examination is not always practicable. The usual routine advised by the text books is to examine the urine once a month for the first seven months and then twice a month during the remainder of the pregnancy. But while emphasizing the importance of early diagnosis, it is only logical to recommend a more frequent examination when conditions permit. A safer practice would be to examine the urine each week during the latter half of pregnancy. Where there is any reason to suspect a pre-eclamptic tendency, this becomes imperative.

Equally as important is the blood pressure reading. Any elevation above 130 mm. of systolic pressure must be regarded as significant. Any patient complaining of headache, or lassitude, or oedema with an elevation of blood pressure especially if the urine is reduced in amount and contains albumin should be considered a pre-eclamptic and treatment should be at once instituted before the more severe symptoms appear—the persistent severe headache, visual disturbances, epigastric pain, etc.

The mild cases, or more properly, the cases where the diagnosis has

been made while the symptoms are as yet mild, should be put to bed and every effort made to keep the symptoms mild, if not to cause their complete disappearance. A rigid routine undertaken early is far better than the same routine late in the disease. The best control on the treatment provided, as well as the most certain indication of the prognosis will be the effect on the blood pressure, the quantity and quality of the urine excreted and the subjective symptoms of the patient. Although one does not depend on it alone, complete rest may be the essential help in pre-eclampsia. This simple measure results beneficially in the following ways: extra work incident to the erect posture is taken from the capillaries, heat regulation becomes simpler, less muscular and nervous energy is expended, and the quantity of food necessary to maintain proper nutrition can be much reduced. Protein and fat can be diminished to a total intake of from 60 to 70 grams a day with beneficial result,—as has been inferred from the experience of the Central European countries during the war when the incidence of pregnancy toxaemia fell to a minimum during the years when those substances were not easily procurable. Sodium chloride in some cases may be restricted as there is evidence to show that it is retained in the tissues and favours the appearance of oedema. The liquid intake should not be in excess of the ability of the kidneys to eliminate it and this is best controlled by the estimation of the 24 hour output of urine.

At this point one notes that the orthodox obstetrical teaching is at variance with the modern therapeutic conception of the internist, who holds that if the kidney is excreting an average amount of urine it is illogical to provide the body with the two or three fold excess of fluids recommended in so many of the standard text-books; and, also, that if the nephrosis present is so severe as to diminish markedly the urine excretion, it is not only illogical but dangerous to overburden the damaged kidney with excessive fluids. Far better, the internist holds, is it to stimulate excretion by the bowel and skin and give the embarrassed organ rest. Which view is right depends on the correctness of the analogy of other types of nephrosis to the pregnancy toxaemic kidney. Milk is the traditional diet for these patients and has proven of great value, but one must note the theoretical objection, from what has been said above, that milk contains too much water increasing the fluid intake above the desired amount and too much protein and salt to come within the required limits. Perhaps it would be satisfactory to rely on carbohydrates, e.g., the 5 and 10% vegetables, to supply the deficiencies after providing sufficient milk to supply the needed protein. Prof. J. W. Williams, whose text-book in a recent edition has just appeared and who is in accord in this matter with orthodox obstetrics, advises a diet of from two to three quarts of milk with copious water drinking during the twenty-four hours; and as this type of treatment has proven satisfactory to the great majority of clinicians, the advisability of revising it with reference to the more theoretical reduction of fluids with the substitution of carbohydrates without salt awaits the dictum of conclusive metabolic studies. Usually these measures—complete rest and diet combined with saline purges of Rochelle or Epsom salts result in a marked improvement in the symptoms, decrease in the albuminuria, and a fall in blood pressure and the pregnancy with continued care and observation may go to a successful conclusion.

In the more obstinate cases, starvation for a day or two and a venesection of from 500 to 1000 c.c. sometimes effects an improvement.

When in spite of treatment, the headache remains persistent, the blood pressure does not drop below 180 mm., with increasing severity of symptoms and visual disturbances, eclampsia can be avoided probably only by emptying the uterus. For this, the method of choice will depend on the urgency of the case, the viability of the child, and the degree of softening and dilatation of the cervix. Usually where the cervix is well taken up or partially dilated near term pituitrin induction will succeed, but in the earlier cases recourse may be had to use of the bag and bougie.

Some advise Caesarian section in urgent cases of threatened eclampsia where there are indications of difficult labour due to primiparity, contracted pelvis, or the vague term, the "long rigid closed cervix".

That eclampsia is always avoidable can neither be proven nor disproven, but that it is usually avoidable is a fact, and treatment should always have its prevention as its object.

III. *Eclampsia.*—When convulsions have occurred, the treatment will depend on whether the convulsions are ante-, intra-, or post-partum. In the case of the two former types there have been two widely diverging schools of opinion, the radical school who advise immediate emptying of the uterus and the conservative school who treat the patient and make no attempt to force delivery until the cervix is fully dilated or at least easily dilatable. And it is becoming increasingly evident that the conservative methods of treatment give the best results. The radical employment of Caesarian section in ante-partum eclampsia naturally reduces the foetal mortality, but at the cost of maternal lives as is proven by the comparison with the results of conservative methods. Intermediate between these two schools are those who for certain indications resort to Caesarian section, e.g., where labour promises to be prolonged, and, in other cases employ conservative measures. The prevalent tendency towards conservatism in the treatment of this malady is now more than ever apparent; and the recorded results are convincingly an improvement over those attained by radical means. But while conservatism has won the day, it is also apparent that there is considerable difference of opinion regarding the details of applying it. It is in the application of the following three factors of treatment that the divergence in the various clinics consists: 1. Use of sedatives; 2. stimulation of elimination; 3. use of venesection. Stroganoff in 1901 published a large series of cases remarkable for the low maternal mortality achieved and again in 1923, a series of 230 personal cases with a maternal mortality of 1.7%. His technique in brief is as follows:—when the patient is first seen, morphia gr. ¼; after one hour, chloral hydrate grs. 30 in 200 c.c. of saline per rectum; after 3 hours morphia gr. ¼; after 7 hours, chloral hydrate grs. 30; after 13 hours chloral hydrate gr. 20; after 21 hours chloral hydrate grs. 20. He administers chloroform to control the convulsions, employs cardiac stimulants, does not effect delivery until the cervix is fully dilated, and if more than three convulsions occur, he removes 400 c.c. of blood by venesection.

On the other hand, the Dublin school led by Tweedie published striking results in 1903 emphasizing the employment of eliminative measures. In this method starvation, stomach lavage, colonic irrigation

and submammary infusion of soda bicarbonate solution are used. Sedatives are not used and delivery is effected only after the cervix is fully dilated.

The above represent two types of treatment and to these may be added a third.

In 1922, McPherson published good results with the following technique. The eclamptic patient when first seen is given hypodermically morphia gr. ½; the stomach is washed out, two ounces of castor oil being left in the stomach; a colonic irrigation is done using 5 gallons of 5% glucose. If the blood pressure is over 175 mm., a venesection is performed and the pressure brought to 150 mm. Morphia gr. ¼ is now given every hour until the respirations drop to 8 per minute. "At this time convulsions have usually ceased, the patient will have fallen into labour, and, as has happened in practically all of our cases, will be delivered normally or by an easy low forceps in a short time."

The treatment usually followed in this hospital is as follows:—the patient is placed in a quiet, darkened room, a nurse being in constant attendance until the patient is definitely out of coma. Morphia gr. ½ is given hypodermically, a catheter specimen of urine is obtained for examination, and a vaginal examination is made to determine the degree of dilatation of the cervix. Care should be taken by the nurse to avoid unduly disturbing the patient and to prevent her injuring herself during the convulsion. The foot of the bed should be elevated, the patient turned on her side, and mucus wiped from her mouth if she is comatose. A stomach lavage is done and two ounces of castor oil is poured down the tube before removing it. The bowel is washed out until clean with 5% glucose and the colonic irrigation may be repeated every four hours. It is worth noting that there is a danger in some cases in over-treatment as disturbing the patient too frequently seems to provoke the convulsions. If the blood pressure is over 180 mm. a venesection may be done to reduce the pressure to 120 mm. This may require the removal of from 500 to 800 c.c. of blood. The morphia may be repeated in ¼ gr. doses at intervals of 2 hours or more depending on the recurrence of the convulsions and the rate of respiration, which should not be allowed to drop below 9 per minute. When the patient is conscious she is given magnesium sulphate, one ounce every hour for 6 doses. A hypodermoclysis of 5% glucose is given continuously, ten ounces per hour for 10 or 12 hours depending on the rate of absorption. Where the kidneys are failing to secrete, a hot pack is of service but cardiac depression must be guarded against when this is used. If labour has set in, delivery is effected when the cervix is fully dilated, ether being used for anaesthesia. If labour does not supervene the case may go on successfully to term after the convulsions have been controlled. This however rarely occurs and during the period of amelioration following the convulsions, the persistence of the elevated blood pressure, the renal insufficiency and the general condition of the patient urgently indicate induction by bag, bougie or pituitrin.

Post-partum eclampsia is similarly treated by sedatives, elimination and venesection.

The convalescence post-partum of eclamptic patients is rapid, the urine and blood pressure regaining a normal condition during the early weeks, usually within ten days. An important point would seem to be complete starvation during the two days following the last convulsion, as the administration of even milk has been followed by severe relapses.

ON CARDINAL PRINCIPLES IN CARDIO-LOGICAL PRACTICE*

A British Medical Association Lecture delivered to the Sheffield Division, October 24th, 1919

BY

Thomas Lewis, M.D., F.R.C.P., F.R.S.

In working for the Army Medical Services during the years of the war, and in working for the Ministry of Pensions since its inception, it has been my good fortune to have been more closely associated with my brethren of the medical profession in daily work than at any previous period. My duties have brought me exceptional chances of seeing the routine work of many medical men while they have been dealing with patients classed as cardio-vascular. For a long while I have been aware that a large proportion of practitioners in this country experience a feeling of insecurity when they handle cardiac cases, and, during the period to which I have referred, it has been a special purpose of mine to understand why these maladies should be regarded as perplexing.

For very many years after Laennec's discoveries the sounds of the heart and the murmurs produced at the several orifices have received extraordinarily minute attention. They have been divided and subdivided; they have been written of from this standpoint and that, though chiefly from the standpoint of the cause of the sounds. More recently, methods of percussion have undergone a similar and intensive study; more recently, and in great array, special instruments have been devised, including sphygmographs, polygraphs, electrocardiographs, sphygmomanometers, special stethoscopes, and from those who have employed these there has streamed forth a prodigious amount of writing. During the last few decades the eager search for the new has piled up the mass of detailed knowledge; the pile has been growing in geometric progression. The day has long gone during which any general student of medicine could keep pace with contemporary writings. He is now faced with an extraordinary medley of statements, simple, simply abstruse or technically abstruse, of which it is no longer possible for any one individual to test or judge the accuracy. We know that some vital facts have come to light; we suspect and know that a considerable proportion of the claims set forth will not be justified by time.

Side by side with this progress new terms have been introduced, old terms have changed in meaning; throughout hypothesis has run riot. A very great deal of the work, a very great deal of the thinking, has, from the standpoint of the exact sciences, been conspicuously slipshod. The over conscientious and passive student quickly acquires a clogged mind. To judge the true from the false, the large from the small, tries the faculties of those who select and pursue a limited sphere of study; it is impossible to those who have no intimate knowledge of the subjects discussed. The effort to keep pace has led many, unwisely, to acquire a smattering of things beyond their province—to use terms the meanings of which they have never been able fully to grasp. Time for tests and for reflection is shortened or is gone; the mind is confused by an ever increasing flood of new ideas and suggestions. In this maelstrom general principles have striven to survive; some have succeeded, some have been raised to undue prominence, others have sunk from sight; in the raging of troubled waters all have been, and still are, in peril. There arrives a time when an attempt must be made to sift from the wreckage—a time when it is expedient to assess values.

Medical men are hampered in their work to-day by the complexity of ideas, by a consequent absence of system, by the use of terms which being undefined convey inexact or different meanings; by a failure to judge what is within or without their province and power.

In discussing problems of diagnosis and of prognosis certain questions recur. Of the many prevalent ideas some appear to me no longer acceptable or serviceable; a few of the more prominent of these I propose to discuss, using them as illustrations of my general theme. But the main object of my lecture is to point to what I regard as essentials, not in research work upon heart disease, but in the routine handling of unselected patients. To simplify my subject I shall deal with chronic maladies only. I

*During recent years so many new facts have been added to the physiological aspect of cardiology that comprehensive articles which in any degree attempt to survey the field are of great value. This article is reprinted from *The British Medical Journal*, November 15, 1919.

shall also confine myself to common maladies, for if we can devise a system of managing such, for the moment satisfactorily, we shall have accomplished the larger part of our task.

The Division of Heart Affections into Organic and Functional Groups

An idea is conveyed to us, we receive and adopt it, and *it grows*. Sometimes it grows unreasonably, sometimes beyond recognition. But it has seized our minds, we encourage it, and in the end, if we allow it to do so, it masters us. The old idea of dividing heart affections into organic and functional is an instance of this kind; it has grown out of all reason. This preliminary classification no longer occupies the place proper to classification; a good classification is a servant. It has been so fostered that it has come to occupy a predominant place; latterly its hold upon the professional mind has seemed almost tyrannical. When the war came it entrenched itself behind earthworks long prepared for it, those preposterous terms, "V.D.H." and "D.A.H.", into which all patients with real and most of those who imagined affections of the heart were in the end strictly divided. Since the war the idea still remains firmly rooted, for with its great reserves it won the day; and with the fruits of that easy victory the medical services of the Ministry of Pensions are now ceaselessly struggling.

As it stands, the idea with its growth of associations is mischievous. It has become so by the inexactitude of its terminology. The most frequent question which I am to-day asked in regard to cardiac cases is this: "Is there or is there not organic disease?" The answer must be "Yes" or "No". It is a question which, personally, I studiously refuse to answer; it is a duty to refuse, and the duty, I think, of every medical man. The manner of the answer is dictated; "organic" disease is a disease in which there is structural change; the remaining cases are "functional".[1]

The issue seems clear: Is there or is there not structural change? But the issue is not clear, nor it it useful; on the contrary it is mischievous. We must inquire the purpose of the question, the manner in which the answer is to be used. If, in diagnosis, the cases are divided into two groups—"organic" and "functional"—according as there is or is not structural change, this division and its meaning will not be respected; for while I am asked whether structural change exists or does not, the answer is read as "serious" or "trivial". It never has been shown, nor will be shown, that all instances of structural change in the heart are serious; it never has been shown, nor will be shown, that affections in which the heart is suspect, but which are accompanied by no evidence of structural disease, are of trivial import. Yet such are the almost universal and instant assumptons as the affirmative or negative answer is given. The question is a concealed trap of our own setting. The answering of it is a prevalent cause of needless wrangling and heart searchings; the answer, when it comes, is a fertile source of misunderstanding and injustice. If there is no structural disease of the heart, it is usually true that the disturbance of the heart is not serious; but that does not mean that the malady from which the patient suffers is not serious, it may be extremely serious. The heart is a very susceptible index of health, and maladies which in the past have been regarded widely as trivial (functional) though primarily cardiac, are almost certainly not primary cardiac maladies, but as a rule disturbances of the heart secondary to disease elsewhere.

A sound knowledge of those affections which perturb without injuring the heart is essential in dealing with patients supposedly suffering from cardiac maladies. Three-fourths at least of the cases classed as cardiac at the present time are not primarily cardiac at all. Because the heart's action is disturbed in these patients, and because the most obvious symptoms and signs seem to point to the heart, that organ gathers to itself almost exclusive attention. In such cases it is not infrequent that clear signs of disease in some other organ of the body are entirely overlooked; in such cases it is frequent that less conspicuous signs of disturbance elsewhere are passed by. It is a sound rule in dealing with a supposed cardiac malady to search the whole body minutely for sources of infection when signs of such heart mischief as is known to upset the circulation are not forthcoming. The question, "Is there or is there not organic disease?" is not a necessary question. A man who is wise cares little whether he has structural change in his heart or not; the State, if it were wise, would be equally indifferent. I place this statement in a context from which it is not to be removed. A wise man

[1] I am aware of my venturesomeness in thus interpreting the definition of this term; some will disagree with this interpretation; yet it is frequently, if not usually, used in this sense. When a medical term is open to two definitions it is time it was abandoned.

cares whether he is fit or not for work and if his prospect of health is good or bad; these are questions distinct from that under criticism. Here is an extreme illustration: A man has a scar in the skin of his leg and presents that leg for examination. Who cares that the scar constitute structural disease? A man may have a similar scar on his pericardium or on the edge of his mitral valve, a healed scar which never has and never will cause him inconvenience, providing no medical man discovers in him the signs of it and misinterprets its significance. When we see the scar on the leg we want to know how the leg works; when we find the signs over the heart which *may* mean a scar in the heart, it behooves us to inquire how the heart does its work; that is the important consideration.

It will be perceived that I have in mind the systolic murmur and its significance. A systolic murmur over the precordium tells little or nothing of a man's capacity for work or the advisability of his engaging in it; it tells us little or nothing of the man's prospect in life. I do not propose to enter here in detail upon the evidence for this statement, for time is limited and I have somewhat recently written fully upon the subject. But I suggest to those who still experience misgivings in the presence of systolic murmurs that they should examine a series of healthy young men, not, as is the custom, under conditions of rest, but after a few minutes of fairly strenuous exercise; they will discover that the healthy heart is not always so noiseless in its movements as has been imagined, and will, I think, be persuaded that systolic murmurs, soft, harsh or conducted, are natural phenomena when the organ is accelerated by exercise. They will find in these young men precisely the signs which have been used widely during the period of the war as evidence of "organic" disease of the heart, which have led to so many improper rejections of recruits, to so many improper discharges from the service, and now form the basis of many unnecessary or unnecessarily high pensions.

The other side of the picture shows men who are genuinely distressed when they exert themselves in any way, but who, presenting no cardiac signs other than those of a supposed "functional" condition, are dealt with casually or cavalierly. Thousands of these men were unwisely accepted as recruits; thousands more acquired their symptoms during service; and to the last group now belong many who, being regarded as "functional", suffer the innuendoes which that term frequently conveys, and receive as a consequence unjustly small pensions.

Disease of the Valves

Pick up an old, or modern text-book, of general medicine and you will find disease of the heart classified. With one of the chief groupings I have dealt. A subgroup of structural disease is that of valvular disease, and this sub-group receives an emphasis to which it is by no means entitled. At the present day, if one asks graduating students directly, if one inquires less directly of medical practitioners, what varieties of chronic heart disease are recognized, the enumeration will almost always begin in the same way. There are four conditions which stand out in their minds; they are "aortic incompetence", "aortic stenosis", "mitral incompetence", and "mitral stenosis". As often as not the list begins there and ends there. Ask what cases lie in the wards of a hospital and, if there are serious heart cases, these are the conditions which will be most frequently named. Now these conditions are not diseases at all; they are descriptions of the events at two of the valvular orifices of the heart; they are dependent, if you will, on disease or imperfection of these valves. To the names as such there is no objection; the objection is to the manner in which they are used. The terms are regarded individually as sufficiently descriptive of many a patient's case; actually each is wholly insufficient from this point of view; *a fortiori*, the term mitral incompetence is insufficient. If I state that I have under my care a patient who suffers from mitral incompetence, you cannot conceive whether the patient is engaged suitably in his everyday occupation or whether he lies moribund; you cannot tell whether his prospect in life is good or is bad; you cannot judge whether he requires treatment or not. The term, used in a diagnostic sense, conveys little or nothing of the facts of the case. "Mitral incompetence" constitutes a diagnosis by fashion only. Precisely the same remarks apply, though somewhat less forcibly, to the remaining terms.

A classification of heart disease of this kind has but a minor value for purposes of description, or for guiding prognosis or therapy. When medical men are so imbued with the supposed significance of valvular disease as to regard its diagnosis as the chief end point of the examination. then valvular disease occupies a grossly exaggerated position in their thoughts. Such, unhappily, it possesses in the minds of many, I would say of the majority of medical men to-day. How often is astonishment expressed

when a patient comes for examination (or to autopsy) with dropsy, or a greatly enlarged heart, and no disease of the cardiac valves. The reiteration of such surprises is in itelf remarkable. Grave disease of the heart, in the absence of disease of the valves, is extremely common in the elderly; it is also common enough in the young.

There is another curious way in which the emphasis of valvular affections leads to grave misconception. I have said that the named conditions of the valves are not diseases at all; yet they are commonly regarded as such by those who fail to reflect. Many intelligent students and graduated men are so misled by these terms that they come to regard the presence of two such conditions as constituting a double disease. The terms "double aortic", "double mitral" are sufficiently commonplace to bear witness to this tendency. Nevertheless, there is in these patients but one lesion of the valves. Loose speech of this kind consorts with loose thinking; the use of the adjective "double" conjures up a grave prognosis. Heedlessly, a man who presents aortic stenosis, and its almost invariably associated regurgitation, is regarded as in much more serious case than is he who presents regurgitation alone. I know of no evidence that this is so. The presence or absence of stenosis in a patient who shows regurgitation is certainly not a prime factor in arriving at the prognosis, it is at the most a very subsidiary point. The misconception is even greater when the mitral valve is in question. Often, after a diagnosis of stenosis of the mitral valve has been made, the doctor's expression grows ominous as he detects a systolic bruit. In point of fact, the detection of this second murmur adds nothing whatsoever to the seriousness of the prognosis; that it does is nevertheless a very common belief. It is a belief due to lack of reflection; there are good grounds for the view that stenosis of this valve is always accompanied by regurgitation. Might we not even argue in general that the greater the stenosis the less in all likelihood is the regurgitation? But it serves no good purpose to argue such matters, the practical test of those who watch the progress of these cases shows that the point is entirely subsidiary; so, incidentally, is a systolic apical murmur in a patient who has disease of the aortic valves. Detect mitral stenosis and you need waste no time inquiring into the question of incompetence; there are far more serious matters to weigh. At the present time cardiac prognosis, as it is widely practised, is perilously near to counting murmurs and assessing the gravity of the outlook in proportion.

Both for prognostic and therapeutic purposes there is value in ascertaining lesions of the aortic and mitral valve. Speaking quite broadly, there are two conditions of these valves which it is imperative should be recognized whenever it is possible; they are mitral stenosis and aortic incompetence. To recognize stenosis of the aortic valves when regurgitation is known to exist, to recognize incompetence of the mitral valve when mitral stenosis is known to exist does not advance us materially. To diagnose aortic stenosis in the absence of signs of incompetence is outside the province of general practice; it is for everyone a hazardous undertaking. To recognize that mitral incompetence is present, while mitral stenosis is not, is a task fraught with not inconsiderable difficulties; furthermore, when it is done, it gives little or no aid when we come to the prophecy.

In brief, in dealing with chronic heart affections, there are but two conditions of the aortic and mitral valves, there are but two common conditions of any heart valves, which will repay a general physician expenditure of much time and thought; these are incompetence of the aortic valves and stenosis of the mitral valves. Both these conditions may usually be diagnosed with confidence, for it is their habit to present signs of an unequivocal nature. That is of high importance; a step taken with certainty is of far greater value than one taken even a little less confidently. A prognosis is too important a thing to mould on anything but a secure basis.

The comparative importance of these diseases of the aortic and mitral is to be emphasized from a second standpoint—the diagnosis carries conviction of an inflammatory or degenerative lesion of the heart. When we know that a patient has a regurgitant current of blood from aorta to ventricle, or when we know that the current is obstructed between left auricle and ventricle, we have learned something of the extra burdens which the heart muscle must bear in its work. Nevertheless ,that knowledge is outweighed by a further conclusion which may be found for practical use. It is that the heart as a whole has been exposed to and has probably suffered damage; it is safe to assume for practical purposes that when these valvular lesions exist the muscle of the ventricles is in greater or lesser degree faulty. There are some exceptions to this rule, but these are comparatively rare; one of the surest ways of diagnosing a faulty myocardium is to diagnose it in those who present mitral stenosis or aortic disease, and to diagnose it purely on the knowledge that these valve lesions exist; especially does this statement apply to aortic disease. It is my confident belief that, had systolic murmurs and

modifications of the heart sounds never been discovered, the practice of the profession would have stood on a much higher plane to-day than it actually does. (I do not say that it *must* have stood higher, but that it *would* have stood higher.) As these signs are used by medical men in general at the present time, they are productive of infinitely more harm than good. They are not useless signs, but they are signs frequently misinterpreted; their value is limited. When a police officer on his night round spies an open window, it behoves him to inquire; he is unwise to conclude there is a thief in the house. These cardiac signs are hints to us, useful guides to possible local mischief; that is their proper status in an examination, but it is not the status which they have.

Prognosis in cardiac affections, as it is generally practised to-day, is pitifully inaccurate; because that fact is generally recognized it is equally diffident; what is not understood is that far greater accuracy is easily within reach. Accuracy, or, more strictly speaking, comparative accuracy, is regarded as unattainable; that is chiefly so because the broad principles and the outstanding facts have been lost to vision in a cloud of relative trivialities. Methods of examination, some useful enough in their proper sphere, many more of very dubious value, have been introduced. The subject as it is written and expounded has grown inordinately in complexity and the landmarks have vanished. Because a physician has possessed himself of an electrocardiograph, a polygraph, an X-ray machine, a blood pressure instrument, or some ingenious form of stethoscope, it does not at all follow that he has become competent to judge a patient's condition; not infrequently the very reverse is the case, for more often than not the limitations of these devices are far from being comprehended. In this opinion I am absolutely at one with the recent pronouncement of Sir James Mackenzie. The signs which foretell favourably or the reverse can be elicited at the bedside by simple means, and the devices to which I refer had far better be left untouched than handled, as they often are, improperly.

The remedy, so it seems to me, which alone remains to the general practitioner to-day is simple but drastic. It is to fasten on to certain cardinal points and seriously to study their values—to take these cardinal points as a basis of everyday work and for the moment to discard what remains. It is to adopt a simple and broad scheme and to obtain a full knowledge of that scheme by applying it to patients; to disdain more comprehensive and flattering plans, of which at the most a mere smattering can be acquired; to work with those instruments which are always at hand and familiar; to become expert in the use of simple means, rather than indifferent manipulators or puzzled worshippers of instruments wholly or partially beyond general comprehension; to start from an assured basis and to build from that *slowly* and steadily.

Examination of Chronic Cardiac Affections

I come to what I hold to be the cardinal points in the daily examination of chronic affections of the heart, and place first and foremost:

1. The Symptoms and Signs of Cardiac Failure

These are subdivided into two categories:

(*a*) *The Early Evidences of an Impaired Circulation.*—These are constituted by the symptoms which produce distress on exercise, and the three chief are fatigue leading up to exhaustion, breathlessness, and pain. In all patients, whether they are the subjects of actual or supposed cardiac disease, to know the tolerance of physical work is more than half the battle in arriving at a correct estimate of the case. A knowledge of the body's reaction to exercise in health, in ill health, and in the chief forms of heart disease is paramount. I do not mean the rise and fall of pulse rate or of blood pressure; they are of service; but those who measure the reaction in this way almost completely fail to appreciate the essential, which is to know the amount of work which must be undertaken to bring forth *distress*. This method is of such importance that I shall emphasize it by the following considered statements.

No man is competent to manage affections of the heart who has not a thorough grasp of this method, a method which is within the easy reach of every medical practitioner. He may have an exhaustive knowledge of electrocardiography, polygraphy, blood pressure, percussion, the stethoscope, and what not; as a practitioner he is better without that knowledge if the first knowledge is lacking.

Standing by itself the method is of more consequence than the remaining cardinal points which I shall name. That is so because no patient who has a normal exercise tolerance has grave heart disease, and because the gravity of the disease in a series of

real heart cases is proportioned to the degree of distress produced by a given amount of work more nearly than it is to any other observable phenomenon within our knowledge.

(*b*) *The Signs of Cardiac Failure of the Congestive Type.*—These require no description beyond the statement that I refer to cyanosis and to engorgement as observed in the veins of the neck and in the liver. The exercise tolerance is never normal or near normal when these signs are present; they are late signs. When *signs* of failure appear the disease is in an advanced state.

2. The Signs of Cardiac Enlargement and its Degree, without attempt to Differentiate Dilatation and Hypertrophy

Time will not permit me to expand on this subject. I would say only that, in respect to these, palpation ranks before inspection and percussion, and that the chief sign is the position and extent of the maximal thrust and the structures it involves.

3. Signs of Valvular Disease

Cardinally these comprise (*a*) signs of aortic regurgitation, which are obtained reliably as often at the pulse as at the base of the heart, and (*b*) signs of mitral stenosis, of which but two are valuable—namely, a diastolic thrill in the apical region and a diastolic rumble of low pitch, audible over the maximal thrust, and best heard, often only heard, in the recumbent posture after the action of the heart has been accelerated by exercise.

4. The Presence or Absence of Fibrillation of the Auricles

If the heart is beating irregularly it should be ascertained whether fibrillation of the auricles is present or not. To obtain the last knowledge a few simple tests nearly always suffice.

(*a*) If there is constant quickening of the pulse during deep inspiration, fibrillation is not present.

(*b*) If the heart beats at a rate of 120 or over,[2] or can be induced by any means to beat at such rates, *while the pulse remains irregular*, fibrillation is almost certainly present.

These tests are not exhaustive, but they are sufficiently so for general practical purposes. The remaining disorders of cardiac rhythm, either on account of their comparative rarity or because their significance in treatment is far smaller, cannot be regarded as cardinal.

5. Infection

No examination of the patient is complete until the presence or absence of infection has been fully considered. The chief signs are:

(*a*) *Pallor*, especially when accompanied by sallowness or duskiness of the facies. This sign is of particular value in cases of aortic disease. Pallor in these cases is of ill omen.[3]

(*b*) *Palpable enlargement of the spleen*, which is not a reliable sign of engorgement of the viscera, but is usually a sign of active infection of the valves in cardiac cases.

(*c*) The presence of small petechial haemorrhages in the conjunctivae, buccal mucous membranes, or in the skin around the base of the neck and shoulders. They are far more frequent than has been suspected until recently, and should be searched for repeatedly in all sallow cardiac patients.

(*d*) *Clubbing* of the fingers, which when slight, is, so I am inclined to think, more frequently accompanied by infective endocarditis than by venous engorgement.

(*e*) The presence of *fever*, constantly or only from time to time.

(*f*) A *pulse rate* constantly over 90 or 100 while the patient rests and the pulse is regular.

(*g*) *Gradual but steady loss of weight.*

Signs (*a*) to (*e*) are more especially signs of infective endocarditis, a condition which in its subacute and chronic forms is much more widepread than is commonly believed, and terminates the lives of a goodly percentage of all cases presenting aortic regurgitation or mitral stenosis; signs (*f*) and (*g*) are also yielded by intoxications.

[2]The faster the rate attained the more certain the diagnosis.
[3]And is not due, as is commonly thought, to the actual regurgitation.

6. When Evidence of Disease is found, its Etiology is to be taken into Consideration

It may be of rheumatic, syphilitic, or other infective origin, or it may result from senile changes. The etiology will control prognosis and treatment in no inconsiderable measure.

The Cardinal Points

These are to my mind the cardinal points, for, in my experience, the great majority of all cases of chronic affections of the heart may be summed up efficiently and sufficiently in terms of them. In routine work instrumental examinations prove useful in checking or revising the bedside tests, but are essential only in a very small percentage of the patients; they prove in practice to be subsidiary methods of examination.

The value of the cardinal points is, so I think, scarcely to be overestimated. I have said that no patient possessing a normal capacity for exercise has grave heart disease; if his tolerance is normal, but he presents cardiac enlargement—considerable cardiac enlargement is always accompanied by a reduced tolerance of exercise—mitral stenosis, or aortic disease, there need be no immediate anxiety. In very rare cases fibrillation of the auricles or a congenital malformation may be seen in patients in whom exercise provokes no undue distress; in these cases also the prognosis is favourable. If a patient presents none of the symptoms or signs falling under the first three headings —that is to say, *if he takes exercise without undue discomfort*, has no cardiac enlargement, no aortic disease and no mitral stenosis—and his doctor tells him on that basis that his heart is sound, this opinion will be justified in all but very exceptional instances, and the chief exceptions are the rare cases of fibrillation of the auricles and of congenital heart mischief to which I have referred already, and rare instances of paroxysmal tachycardia; even in such cases the blunder would be a minor one; it would be a blunder of less consequence than gravely to warn a patient solely on the basis of a systolic murmur.

Briefly, the first three cardinal points are those which command consideration first; the last three assume cardinal importance in cases in which, on the basis of one or more of the first three points, disabling heart disease is already diagnosed.

Exercise Tolerance

I come to an important consideration—namely, the value of exercise tolerance in the diagnosis of a deficient or overburdened myocardium. It is not a subject I propose to discuss here on a theoretical or detailed basis; my object is to formulate the following everyday rules which in my experience are at present sound:

(*a*) Where there is definite enlargement, or aortic disease, or mitral stenosis, or fibrillation of the auricles, then the safe course for doctor and patient is to attribute any undue distress on exercise to a cardiac lesion.

(*b*) In young subjects, if there is no such immediate evidence of heart disease as I have named in the last paragraph, then a deficient exercise tolerance should rarely, if ever, be ascribed primarily to the heart. To this class belong almost all patients who are supposed to be suffering from "heart strain", and a large number of patients incipiently infected with tuberculosis or chronically infected by pyogenic organisms.

(*c*) In elderly subjects, if there is no sign of structural disease, but a poor tolerance of exercise, the heart cannot be declared free of disease; on the contrary, the heart should be regarded as the probable seat of mischief. It is of course to this class that many cases of grave angina pectoris belong; but it also comprises many myocardial cases, in which the chief symptom is not pain but breathlessness or undue fatigue.

Some General Principles in Treatment

Regulation of the Heart's Work and Rest

The cardinal principle in treating chronic heart disease is suitably to regulate the physical strains thrown upon the organ. When structural disease exists it is for the most part incurable, and as such it should be recognized. When, as an accompaniment of the minor forms of disease —for example, suspected scarring of the mitral valves— the capacity for exercise is unimpaired, there is no need to curtail the patient's energies. But if structural disease is judged to have limited the heart's reserve power, *because*

effort is followed by undue breathlessness, by undue fatigue or by pain, then the patient's activities, in work and in play, should be controlled; they should be so regulated that such symptoms of distress are not provoked.

It is not often good practice to limit the activities because some physical sign other than a sign of distress is discovered.

It is not good practice willingly to allow a cardiac patient to call forth his whole reserve, and consequently to suffer pain, undue breathlessness, or fatigue. Those acts, strenuous or leisurely, which bring distress are to be prohibited; in one case strenuous games or heavy labour, in another case quick movement on street or road, in another the act of standing, in another unnecessary movement in bed, is to be forbidden, according as much or little exertion provokes symptoms. A cardiac patient is unfit to be on his feet if, when up, he becomes breathless, experiences cardiac pain, or quickly tires. The presence of symptoms in a cardiac patient when he stands at rest or moves leisurely is the first and chief indication of bed treatment. Cardiac patients who are breathless while in bed are usually very gravely ill, and in these it is necessary to try with all our means to reduce the work they do by waiting on them hand and foot. A very important consideration in such patients is to induce long hours of sleep, for during sleep the greatest measure of rest is obtained.

There are three indications which call for the bed treatment of cardiac cases. The first and most important I have indicated; it is that distress is caused by the act of rising to the feet or by walking leisurely. The second is that active infection is thought or known to be present. The third is that drastic treatment with a drug of the digitalis group is required.

The chief value of digitalis lies in its power to control the ventricular rate when fibrillation of the auricles has come. In most patients in whom this disorder of the heart is discovered the ventricles beat rapidly, at rates of 120, 140, 160, and even more per minute. It is this rapid action which fatigues the heart, and digitalis, by lessening the rate, lessens the fatigue. The normal heart rate, while the body is at rest—to take approximate and convenient numbers—is 60 beats to the minute. Each ventricular cycle lasts one second; of this, one-third is occupied by systole, two-thirds by the resting period of diastole. The heart works one shift and sleeps for two. But if the rate is 120 beats to the minute, then each cycle lasts half a second; systole lasts a quarter of a second and so does diastole. Work and rest alternate in equal shifts. As the rate of beating rises, so is systole increased relatively at the expense of diastole. Very important is it, therefore, to reduce the heart rate where this is excessive. A chief cause of rapid heart action where heart failure threatens or has come is fibrillation of the auricles, and it is in this condition that digitalis acts so beneficially; it reduces and holds the rate within normal bounds.

The reduction of accelerated ventricular rate is the only important action of the drug upon the human heart of which we have knowledge. There are few, if any, instances of which we know with certainty in which digitalis acts beneficially, except cases of accelerated action; there are few instances of acceleration in which the drug produces unquestionable benefit apart from those provoked by fibrillation of the auricles. The principle of digitalis therapy—and when I speak of digitalis I include the allied drugs, strophanthus and squills—is that, administered to suitable cases, the heart, by means of it, obtains rest. The giving of this drug to unselected cardiac cases is much to be deplored. Those who regard digitalis as a cardiac stimulant mistake its character; its chief action is to rest the heart. *To the heart foxglove is not tonic, but powerfully hypnotic.* It extends the diastoles of the heart; it extends the period of sleep.

There is a direction in which medical men are much hampered in dealing with chronic heart disease. It is in trying to order the future lives of working class men to suit the heart's power of reserve. Many cardiac patients leave our hospital wards after a short period of rest, a period during which there has been much improvement of the heart's capacity for work. Yet these patients are but too often totally unfit to take up again those daily tasks in and by which they have already suffered. To tell a working class man that his former work suits him ill, to tell him that he must find new work of lighter grade, is good enough advice; but how often is it within the man's power to act on that advice? how often is it within the doctor's power to see that his advice is followed? We greatly need in this country a system by which disabled workers are placed and cared for in suitable employment. Cardiac cases are for the most part conspicuously willing workers, frequently too willing; there are many men doing heavy work in this country to-day, and at the same time surely, but may be slowly dying of heart disease. It is a shameful thing that these unfortunates are put by hard necessity to tasks far beyond their endurance.

Work is good for cardiac cases, and it is good for men in whom the voluntary muscles of the body are ill conditioned, but only such work as falls well within the bounds of the heart's reserve is beneficial. It is a most important matter, and a matter very little attended to to-day in hospital practice, to test a man's capacity for work before he goes to his home; it is not sufficiently understood that discharge from hospital is read by many as a sanction to return to the old work.

INFECTION

As infection is the chief cause of heart disease, in the stage of its inception, and in the stages of its advance, so, when we come to treatment, to stay the advance by removing the cause is a chief principle. The treatment of early syphilitic lesions of the heart by appropriate measures is a field as yet little explored, but one which is in promise fertile. To treat drastically local invasions by pyogenic organisms is clearly indicated, and of proved benefit in many cases. Even more important is it to guard against infection. Cardiac cases run very serious risks, risks which but too often cannot be avoided, by contact with those suffering from some infection of the respiratory tract. Nevertheless, much harm may be avoided by timely warnings of dangers, met in the family circle, in crowded buildings and in ill-ventilated rooms, by the prescription of the open air régime, and, in bed cases, by rigorous separation from febrile cases.

CHEMISTRY AND MEDICINE

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There are many medical students who look on Chemistry (and probably also Physics and Biology) as being disagreeable preliminaries to the study of medicine, and ask themselves why they should be required to spend time over it when, if they wish for medicines they have but to requisition the aid of the druggist. Many look on it as a subject to be got over, and fail to see (though they realize it later) what is the essential connection between it and medicine. If this short article, contributed by request, proves to them that for centuries there has been a closer bond between chemistry and medicine than between medicine and any other branch of science, it will not have been written in vain.

In the early centuries of our era the Egyptians studied the results of experimental facts dealing with matter and the changes it undergoes and taught a theory to account for and connect these. The science was called *Al Chemia* and dealt mainly with the metals, for the all-absorbing search was for a method of transmuting the commoner metals into gold, though some were seeking an elixir which would be a cure for all ills. This was the objective of experimenters until almost the seventeenth century, though through the labours of others in the practical arts there were discovered many new compounds such as natural and artificial colours, dyes, alloys, salts, glass, pottery, and many other things which have been in everyday use for ages. Again, the demands of the physician for medicines led to the investigations of natural products with a view to their curative properties, and complicated draughts were devised and administered to ailing clients who well deserved the term "patient" applied to them! These were mostly vegetable concoctions, obtained by distillation and extraction, and were used for the vaguest

reasons. The use of metals and their compounds did not come into vogue until the sixteenth century when there arose a man who was to revolutionize chemistry as applied to medicine and to concentrate the scattered chemical knowledge of his time.

This was Philippus Aureolus Theophrastus Bombastus Paracelsus von Hohenheim (or ab Hohenheim, as he denominates himself)—known to fame as Paracelsus, born in 1493 in Einsideln near Zürich. His education in alchemy, astrology and medicine was received from his father, who was a physician, and as a young man he seems to have visited most of the important towns of Europe. Later he occupied the chair of Physics at the University of Basle, signalizing his appointment to it by publicly flouting the work and theories of Galen and Avicenna, shaking their medical throne to its foundations, and stating that these two physicians did not together possess as much knowledge as his own shoe-laces! This did not make him popular, yet his evident earnestness induced many medical men and searchers after the Philosopher's Stone to turn their attention to chemical investigation, and metals which were considered likely to be of use as medicines were subjected to the action of numerous reagents with the result that numbers of new products were discovered and used.

While Paracelsus was not himself a scientific chemist he was what modern slang would term a first-class booster and through him and his enthusiasm much chemical knowledge was accumulated. He was of a most aggressive nature, wanting to do things his own way and wanting people to see that his way was the right one. Apparently he had to leave Basle, and one reason given is that a rich canon of the city being ill offered a hundred florins to anyone who could cure him. Paracelsus at once offered to do so and it is reported that after he had administered three pills the ecclesiastic recovered, but on being so soon restored to health refused to pay Paracelsus the promised sum, for which he was promptly sued in court. The judge's ruling was that the physician should only receive his customary fee. Paracelsus, irritated at this decision, uttered the most violent invectives against the magistrate who threatened to punish him for his outrageous conduct. On the advice of his friends he gave up his professorship and fled the country, and appears then to have travelled extensively all over Europe, finally settling in Salzburg where he died in poverty at the age of 48.

The arrogance displayed in his writings, and the coarseness of his language seem to have been well suited to the vulgarity of his age and were even considered a proof of his superior merit. It is unfortunate, too, that he was much addicted to becoming intoxicated. The great Erasmus consulted him about the diseases with which he was afflicted and the letters which passed between them are still preserved; the former's are clear and elegant but those of Paracelsus are ungrammatical and so flowery and involved as to be almost unintelligible.

It is interesting to note that Paracelsus was the first to prepare hydrogen gas, obtaining it by the action of dilute acids on metals. It was not, however, until the time of Cavendish (1766) that the true nature of this gas was made clear. He was also the first to include animal and vegetable bodies under the same heading and according to his theories a person was in health or otherwise according as the organism contained these constituents in their normal proportions or otherwise. He recom-

mended the use of preparations of mercury, of opium, and of antimony, and a new class of chemical physicians arose as a result of his teachings. The work of these was frowned upon, as to administer chemical preparations as medicines was at that time "not done". To get over this difficulty these physicians gave them fanciful names with the result that their patients were satisfied and happy. As time went on the number of medical chemists grew and gradually supplanted the alchemists and pretenders who are typified by *Subtle* in Ben Jonson's play.

If the mysticism and absurdities are winnowed from Paracelsus' writings much that is instructive remains. While his ideas on physiology are inextricably mixed up with the influence of the sun, moon, and stars on the human body, one of his doctrines is worth a passing reference. He held that there existed in the stomach a demon called *Archaeus* presiding over the chemical operations taking place in it, separating the poisonous from the nutritive part of the food and furnishing a "tincture" which rendered it capable of assimilation. He recommended all physicians to study this "ruler of the stomach" (which he also termed "nature"), stating that it and it alone cured disease.

The true use of chemistry was, according to Paracelsus, to prepare medicines, and he advocated the discarding of large potions and introduced the preparation and use of small doses of "the quintessences" of substances, as well as of mineral and saline medicines. He may have been a charlatan but he gave an enormous stimulus to medicine in the sixteenth century, raising the status of chemistry so much that after his time it became an essential part of a medical man's education. Thus a new school of medicine came to be founded, and while many followers of Paracelsus adopted and carried even further the absurdities of their master, others separated the wheat from the mass of chaff and schools were formed for the study of the preparation and use of drugs. One of these was in connection with a botanical or herb garden in the neighbourhood of Paris from which ultimately grew the Jardin des Plantes and the medical and science school which forms part of it. Another chemist (John Beguinus), who settled in Paris early in the seventeenth century, opened a laboratory, gave lectures and compiled a small manual —the first real text-book of chemistry ever published—which was so successful that it went through an edition a year for fifty years!

This impetus given to the study of chemistry led to pharmacy becoming a well-defined subject and also opened up a field for general investigation and for theories of chemical action deduced from experimental facts. And here chemistry did more than merely add material to the pharmacopoea, together with methods for the purification of and the detection of adulterations in drugs: it investigated the complicated chemical actions taking place in vegetable and animal life, and thus a knowledge of the constituents of the body and the normal and abnormal changes occurring in it was gradually acquired. Now organic, physiological, and pathological chemistry are specified subjects of study and these cannot be understood without a thorough grounding in general chemistry, at the root of which lies a perfect familiarity with the elements and their compounds, and the various reactions which they undergo.

It should be abundantly evident, both from the foregoing and from a glance at the subjects of study in the medical curriculum, that chemistry will be met at every turn—in physiology, in therapeutics, in dietetics, in

pharmacy, in public health, as well as in practical medicine and in legal medicine; surgery, too, assumes a knowledge of the chemistry of the substances which have made its modern practice effective. The *science* of medicine therefore is based on chemistry; our bodies, like everything else in the universe, are constantly undergoing change and these changes are *chemical*, hence chemistry is a fundamental science, the help of which is demanded in one form or another by all the other sciences, and by none more so than medicine, which depends for its progress and emancipation from empiricism on what chemistry has to tell it.

Let the first year student, therefore, *not* sell his text-books when he has passed his examination! That test is only the first of an untold number of questions which will confront him throughout his course and during his career as a practitioner. There is educational value in its study; there is even another motive for acquiring a knowledge of it, namely, that it will be useful,—nay essential—if one is to attain to any standing other than that of a medical-tradesman. These are fortunately not now as numerous as they were thirty years ago and this despite the fact that the medical student of to-day has infinitely more subjects to study than his predecessors had. The writer once met a doctor who,—but that's another story.

THE "MELTZER-LYON" TEST IN GALL TRACT DISEASE

G. L. Fair '25

A summary of the recent literature on the subject of the "Meltzer-Lyon" test in gall tract disease affords the opportunity of presenting the results of some interesting researches in connection with the diagnosis and treatment of gastro-intestinal disorders. This outline will, I hope, in addition to making clear the justification and value of the test, also throw some interesting light on the pathology of the biliary tract.

There is probably no other problem in borderline medicine and surgery that can compare with the diagnosis of gall-bladder disease in interest, difficulty or importance. So difficult is the diagnosis that William Mayo is quoted[1] as having said: "When there is trouble in the right upper quadrant, only a laparotomy will reveal the exact cause of the trouble". More difficult still is the choice of the wisest method of treatment. We have only to read such articles as that by Deaver[2] on "Operations and Re-operations for Gall-Stone Disease", and those by other equally careful surgeons to appreciate this fact. Too many such patients do not get well or suffer relapses following removal of the gall-bladder and other operations on the biliary tract, which again necessitate operation. The literature is full of cases of these multiple operations on the gall-tract and yet perhaps only a fraction are recorded. That surgeons themselves are dissatisfied with the present state of gall-bladder surgery is shown by their tendency to-day to further experiment with short-circuiting the gall-bladder or ducts to the stomach or duodenum.

Vincent Lyon, chief of the gastro-intestinal department clinic of

Jefferson Hospital, Philadelphia, in advancing his test and his method of non-surgical drainage in diagnosis and treatment of biliary tract disease, gives three reasons for the present unsatisfactory results, for all of which he advocates his methods as a valuable aid:

(1) "Present methods are unequal to the detecting of gall-tract disease in the early stage of catarrh.

(2) The surgeon has been getting his patients too late and has shouldered more than his share of the responsibility—not always through any fault of his own, but more often because the medical adviser has been a diagnostic delinquent or a therapeutic procrastinator.

(3) There has not been developed a practical post-operative method of ascertaining whether or not surgery has actually accomplished what it undertook to do—namely ridding the gall-tract of infection; nor a practical post-operative treatment which will often ensure a complete initial operative success and prevent the necessity for reoperation."

The "Meltzer-Lyon" test (first described by S. J. Meltzer of the Rockefeller Inst.[1] and later perfected by Lyon) consists in the instillation of a strong solution of magnesium sulphate in the duodenum, by means of a duodenal tube, with the object of exciting the peripheral endings of the splanchnic nerves in the duodenum and the common bile-duct, which, by reflex nerve stimuli down the right vagus nerve, will cause relaxation of the common duct sphincter and a contraction of the gall-bladder. This reflex mechanism permits the collection of specimens of common-duct, gall-bladder and liver bile. These three specimens are then examined at once:

(1) *Grossly* for colour, viscosity, clarity, and presence or absence of gritty deposits (cholesterin crystals) or small calculi.

(2) *Microscopically* for cellular elements, bacteria, crystals, leucocytes, and their approximate number per field.

(3) *Bacteriologically* by direct smear, and by culture in broth, on nutrient agar and special media.

The findings are then used to aid in the differential diagnosis of the existing pathological condition of the biliary tract: cystic duct catarrh, atony of the gall-bladder, choledochitis, cholecystitis, empyema of the gall-bladder, cholelithiasis, etc. The method followed in this test has been applied to pre- and post-operative drainage in surgical cases, catarrhal jaundice, arthritis and typhoid carriers.

The actual technique of the Lyon test may be briefly outlined as follows: patients begin the test at 8 a.m.—at least twelve hours after their last (evening) meal. Lyon has described[3] elaborate methods of attempted sterilization of the mouth, oesophagus, and stomach as a preliminary procedure. But Smithies, Karschner and Oleson of Chicago[4] by their experimental work have shown that the bacteriological and cytological findings in duodenal and gastric aspirates from the non-retention stomach and duodenum are similar, even after elaborate attempts toward rendering these parts sterile, to what they were before such attempts were made. They recommend therefore the cleansing of the nasal and oral passages the night previously by antiseptic gargles, nasal douches and teeth-cleaning; drinking copiously of cold water before retiring; and finally a preliminary cleansing of the mouth and teeth prior to the swallowing of the duodenal tube on the morning of the test.

The patient swallows the tube to its second mark. Four ounces of sterile water are then injected into the stomach through it, in order to supply the stomach with a fluid to be emptied into the duodenum, and to encourage gastric peristalsis and thus assist the tube into the duodenum. He is then placed on a bed or couch, in the right Sims' position and swallows very slowly during the next 20 to 30 minutes 15 cms. more of the tubing (*i.e.*, to the third mark). The intubation of the duodenum may be hastened at this stage by raising the hips on a pillow, flexing the right thigh across the opposite one, or having the patient get up and walk around, change his position, or drink broth or water. Finally if difficulty is still encountered—manipulation under the fluoroscope may save a great deal of time. It is best to let the free end of the tube siphon as soon as swallowed—watching the colour of the fluid collected in the receiving bottle at the side of the bed. There are several tests given for the localization of the tube:

(1) A negative test for free HCl in the aspirated fluid—indicates that the tip of the tube is probably in the duodenum.

(2) Drinking milk and attempting to aspirate it through the tube.

(3) Presence of a "duodenal tug" on pulling the tube. (This is unreliable because of possible cardiac or oesophageal spasm.)

(4) The most reliable test is examination under fluoroscope, where the typical S-shaped curve of the tube, necessary to passage through the pylorus and into the second portion of the duodenum, may be seen.

There are difficulties in intubation which should be mentioned here. Extreme nervousness or discomfort on the part of the patient may induce inhibited peristalsis and pylorospasm. This may be prevented somewhat by a preliminary hypodermic of atropine sulphate or the introduction of Tr. Belladonna through the tube. Other conditions such as hyperperistalsis, coiling of the tube, "hour-glass" stomach, tumours or previous gastro-enterostomy may seriously handicap the intubation or render it impossible.

When by any of these tests the operator is sure that the tube is in the duodenum, a little air is injected to balloon out the walls. The duodenal fluid is then aspirated and examined separately: grossly, bacteriologically and culturally as are the specimens of bile. Into the duodenum there is then injected through the tube 75 c.c. of a 33% solution of magnesium sulphate (body temperature). The tube is clamped off for about 5 minutes and then the injected fluid followed by the bile, which comes from the biliary tract is siphoned off. When bile begins to flow, the first sample is collected (largely from the common duct) and subsequent alterations in the gross appearance of the bile are followed—changing the collection bottle in order to segregate the specimens. Failure to get a steady flow of bile or no gall-bladder bile, may necessitate further doses of magnesium sulphate. Lyon advises a second instillation of 60 c.c., and, if this fails, a third one of 45 c.c. or fourth of 30 c.c. always taking care by measuring the return that no more than 90 c.c. are retained. If the test is unsuccessful, it should be repeated at least on three successive days before any conclusions are drawn as to blockage of the common duct, etc.

Before withdrawal of the tube 75 c.c. of a 1 in 5,000 solution of silvol should be instilled in order to disinfect the duodenum from any infectious material that may have come from the biliary tract. A duodenal

enema of 250 c.c. of Ringer's solution should also be given in order to hurry the disinfected material along the intestines. The duodenum is then ballooned out with an injection of air and the duodenal tube withdrawn.

DIFFERENTIAL DIAGNOSIS

(1) *A normal condition should give:*

1. "A" bile (first specimen)—5 to 30 c.c. in amount in approximately 5 minutes time, of a light golden-yellow colour—coming from the common duct, later slightly diluted with cystic and hepatic duct bile and perhaps a few drops of gall-bladder bile.

2. "B" bile (second specimen)—30 to 75 c.c. of a syrupy darker, golden-yellow bile with a viscosity between that of syrup and molasses. This should take from 10 to 15 min. to drain. It is a mixture of the first portion of the gall-bladder bile, mixed with the last of the common-duct bile and still further diluted with liver bile.

3. "C" bile (third specimen)—up to several ounces in amount, of a lemon or straw colour and of low viscosity. This appears more or less suddenly after the "B" fraction and may be collected for some time.

On examination the specimens should show:

1. *Gross.*—There should be very few flocculi.

2. *Microscopic.*—When centrifuged there should be a few desquamated epithelial cells, an occasional leucocyte, a few strands of mucus; less frequently an occasional crystal or a few bacteria.

(2) *Cystic duct catarrh.*

Numerous flocculi appear just before the gall-bladder bile is delivered. If the cystic duct obstruction is complete no "B" bile is obtained. Frequently the flocculi are more compact and have a spiral formation—suggesting their source from the convolutions of the lining mucosa of the cystic duct. They are heavily encrusted with amorphous bile salts (more frequently than are mucous flocculi from the common duct) and often also are covered with an oleaginous material.

(3) *Failure to recover "B" bile may suggest several possibilities,* to be distinguished by the history, X-ray and other clinical findings.

I. Obstruction of the Cystic Duct.
   A. 1. A state of inflammatory oedema of the cystic duct.
      2. The cystic duct may be choked:
         (*a*) By inspissated mucus (see under Cystic Duct Catarrh).
         (*b*) By very fine gall-sand or small gall-stones.
      3. It may contain one or several larger stones which have become impacted.
      4. There may be a state of inflammatory oedema of the racemose glands in the mucosa of the neck of the gall-bladder and first part of the cystic duct.
   B. 1. Adhesions involving the cystic duct.
      2. Angulation of the cystic duct—by pressure or otherwise.
      3. Stricture of the cystic duct.
   C. By pressure exerted upon the cystic duct from without as by:
      1. Tumours in the neighbourhood.
      2. Enlarged lymphatic glands lying along the cystic duct. Thes [illegible] occur at the junction of the cystic with the hepatic duct and may by pressure on the latter cause jaundice.

II. The cavity of the gall-bladder may contain little or no recognizable bile.
   A. Due to the filling of the cavity by multiple calculi of various sizes.
   B. Due to the presence of a single large stone around which the gall-bladder has contracted.
   C. The gall-bladder may be atrophied or fibrotic.

III. The gall-bladder bile may be so tarry that it will not flow or the musculature too weak to force it through the cystic duct.

IV. Adhesions angulating the gall-bladder and so preventing the discharge of bile.

V. Atony of the gall-bladder. This is one condition which Lyon believes can now be diagnosed by this method of drainage, and one which is of extreme importance, because he believes it to be a precursor of gall-bladder disease and formation of gall-stones or infections. The test may suggest it in three ways:

1. *By the recovery of "off-colour" bile*—that is, bile ranging from a deep golden-brown to a greenish-black or black colour with increased viscosity. Microscopically three types of causative conditions may be revealed:

(*a*) *Atonic catarrhal cholecystitis*—from the presence of mucus, desquamated masses of bile-stained tall columnar cells and quantities of precipitated crystals.

(*b*) *Infective cholecystitis*—showing microscopically bacterial flora and colonies, pus, red blood cells and inflammatory débris.

(*c*) *Masked infective cholecystitis*—with swarming bacteria, and static bile but no cytological evidence of inflammation or cell destruction.

These are all conditions which are pathologically in an early stage and do not give interpretable clinical symptoms but give rise to a mixed chain of symptoms, or to a vague atypical dyspepsia. On operation, the surgeon cannot detect any gross lesion—and he may remove the appendix but leave the masked focus to go on to an extreme condition. Lyon advises this test as the only possible way of making an early recognition of these types.

2. *By the amount of static bile.*—The normal upper limit of gall-bladder capacity is usually taken as two and a half ounces (70 c.c.). If therefore more than four ounces are recovered in the "B" fraction—it would seem that the gall-bladder is functionally atonic and unable to move its contents promptly—or that there is obstruction of the common or cystic duct.

3. *By the intermittency of delivery of "B" bile.*—Often in this condition of gall-bladder atony, "B" and "C" biles are alternately delivered.

VI. Where "B" bile is not recovered and we get no other cytological evidence of cystic duct obstruction due to catarrh or inflammatory oedema, we must consider what Smithies[4] calls "physiological block". These reflexes are concerned with the autonomic nervous system and are not voluntary. Smithies[4] in his series of tests found that in the class of excitable, apprehensive people such as Latin-Americans, or "psychically hyperplastic Hebrews"—he got a defective response in 50% of the females and 35% of the males—whereas other groups of patients gave defective response in only 17.8% of women and 18.3% of men.

(4) *Choledochitis or Catarrh of the Common Duct (Catarrhal Jaundice).*—In the "A" specimen will usually appear numerous flocculi which become fewer as "B" bile is expelled. Microscopical examination of the flocculi shows strands of mucus and tall, medium or short columnar epithelial cells. There will also be seen numerous pus cells. Lyon in his work has actually recovered plugs of mucus (1 to 3 cm. long by 3-5 mm. in diameter)—often followed by a rapid discharge of bile. Microscopical examination of these plugs showed that the cells from the duodenal side were not bile-stained and were of the low or cuboidal epithelial type, while those from the duct side were tall, bile-stained and often necrotic. This would suggest that the catarrhal jaundice may be due to an extension of a gastritis or duodenitis.

(5) *Cholecystitis.*—In the "B" bile will be found mucous flocculi showing microscopically bile-stained tall columnar epithelial cells occurring in large masses or commonly in fan-like clusters or rosettes. Other inflammatory elements may also be seen.

(6) *Empyema of the gall-bladder.*—This is easy to diagnose by medical drainage of the biliary tract. Lyon and others have frequently recovered considerable amounts of pus, sometimes an ounce or more. The former advises this test as a possible plan of non-surgical cure or as a palliative treatment until contraindications for surgery have passed.

(7) *Cholelithiasis.*—The recovery of minute gall-stones or gall-sand (cholesterin crystals) is the "sine qua non" in this diagnosis by the Lyon test. The sense of grittiness to the fingers also suggests calculus formation. Also the presence microscopically of large masses of precipitated crystals of cholesterin, calcium, bile salts or pigments, suggests either that the liver is failing to secrete bile capable of holding these substances in solution, or that the bile has become sluggish and static—causing excessive concentration and crystallization. These latter findings do not necessarily indicate formed calculi, but they do suggest a pre-calculus stage.

The following are some of the conditions in which the method of non-surgical drainage, repeated over a considerable period of time, is valuable in treatment:

(1) Those cases which are surgical but in whom there are serious

contra-indications (cardiac disease, renal disease, anaemias, etc.) and in whom medical drainage may be adequate temporarily, until these contra-indications have passed.

(2) Borderline cases formerly considered surgical, but who now might do as well or better by medical drainage of the gall-tract. Such cases present various clinical but almost always vague, historical pictures with atypical digestive symptoms, often classed as functional dyspepsias, nervous indigestions, biliousness and chronic appendicitis. Surgical treatment does not permanently cure this type. Treatment of the collateral causes (oro-nasal foci, and disseminated catarrhal and infected states of the stomach, small and large bowel) in conjunction with medical drainage of the gall-tract will clear up many of these cases.

(3) Early cases for whom surgery is not necessary, and who may have satisfactory recovery by medical drainage combined with appropriate medical measures. Such patients are those in whom by Lyon's test we can demonstrate the earlier stages of gall-tract disease—chiefly gall-bladder and duct catarrhs and infections.

(4) Preliminary medical drainage of genuinely surgical cases. Many cases of cholelithiasis, cystic duct obstructions, and those giving evidence of adhesions involving the right upper quadrant, may have a surprisingly prompt decrease in jaundice, and lessening of general toxaemia, so that they may be operated on with less danger of post-operative shock.

(5) Post-operative medical drainage. Patients who preoperatively show duct catarrh and infection should have medical drainage 3 to 6 weeks after the operation to determine the presence of residual infection. If there is such infection, continued intermittent drainage is advised until the findings are negative. By this method Lyon has suggested that in the future we may be able to return to the "ideal Gall-stone Operation" described by McRedity, an American surgeon in 1884—which consisted in removing gall-stones, inspissated mucus and gall-sand from the gall-bladder, curetting or sponging off its mucosa and then closing the bladder without drainage. At the present time, of course, cholecystectomy, and removal of the stones with cholecystostomy are the two commonly recognized surgical methods of treatment.

(6) Essentially medical cases.

(*a*) *Catarrhal Jaundice.*—This is considered most commonly to be due to an extension of gastro-duodenal catarrh. Together with medical treatment, daily medical biliary drainage has in the experience of Lyon and his supporters [4 5 6 7 8] had remarkably fine results. When Lyon first used this method in 16 such cases at the U.S. Naval Base Hospital at Brest, France, in 1917—9 treated by the usual symptomatic method recovered in an average of 35 days, while the other 7 treated by medical therapy combined with daily non-surgical drainage by the duodenal tube, recovered in an average of 17 days—a reduction of 50% in the period of convalescence.

(*b*) *Arthritis.*—Where all the suspected primary foci of infection in tonsils, teeth, sinuses, prostate, seminal vesicles or female pelvic organs—have been recognized and treated without appreciably arresting the progress of the disease, the presence of a secondary focus in the

gall-bladder or entero-colon should be tested for by this procedure and by culture of the stool. When there was infection in these regions, many patients treated by these men by medical drainage of the gall-tract, combined with duodenal lavage, colon irrigations and use of autogenous vaccines have made permanent recovery.

(*c*) *Typhoid Carriers.*—By applying medical drainage over a period of several days to several weeks—cases are on record where the residual typhoid focus can be culturally eliminated by stool and urine culture.

Space does not permit a discussion of the criticisms of this method of medical drainage of the gall-tract or to give statistical reports of its clinical success. Suffice it to say that Lyon, his associates and other workers [4 5 6 7 8] have published gratifying results with large series of cases and have fairly met by experiment and argument all serious attacks on the test. Its use in a limited number of cases has met and is meeting with a fair measure of success at St. Michael's Hospital, Toronto.

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A SHORT RÉSUMÉ OF THE DEVELOPMENT OF ANATOMICAL SCIENCE

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This article has not been prepared with the intention of trying to present a compact summary of the progress of the science of anatomy, nor with the idea of presenting a compendium of the lives of the most prominent figures in anatomical history, but rather for the purpose of reminding the reader as he makes use of the elaborate anatomical equipment at his disposal, that there was a time when dissectors were handicapped by such obstacles as would discourage all but the most persistent. A volume by Prof. W. W. Keens, "Addresses and Other Papers", has been of great value in this connection; the histories of Buck and Neuburg have also furnished considerable fundamental data.

The first dissectors of whom there is any record, were Greeks of the fifth century, B.C. They did not examine human bodies but confined themselves to the lower animals. Democritus is reputed to be the first comparative anatomist. However dissection was not an established custom—the majority of the physicians of that period contenting themselves with speculation about the composition of the body. As an example one might cite the theory of Hippocrates that the body is made up of four humours, which was accepted for a long time as a fundamental

principle in the study of medicine. This tendency of the Greeks to substitute speculation for observation was not confined to the subject under discussion: it characterizes the entire history of that period. The mind of man had not yet grasped the primary truth of all science, that the key of knowledge is to obtain a reliable series of observed facts. The schools of the early Greeks were wedded to the deductive method of reasoning—they devised a theory and then tried to adjust the facts to the theory.

Professor Newman says, "The Greeks were anticipators of Nature. Their speculations outstripped the facts; in fact, were usually made 'with eyes closed to the facts'. Their theories were inextricably bound up with current mythology, were naïve, vague, and from our modern point of view, ridiculous, yet they contained many grains of truth, and were the germs out of which grew the saner ideas of subsequent thinkers."

Many of the now-established truths of philosophy and science can trace back their ancestry to the unfounded, vaguely expressed "germs of truth" of the early Greeks, but one is concerned only with the fact that the germ of the science of anatomy originated in that first curiosity of the Greeks as to their physical make-up.

In the third century B.C., one finds a distinct advance at the school of Alexandria, in Egypt. The practice of dissecting was condemned by law, by religious authority and by public opinion in so many of the countries of that time, that the Egyptian academy became a world centre for students of anatomy. Herophilus and Erisastratus are credited with the first dissections of human bodies, and they were so eager in their pursuit of knowledge that rumours were spread that they dissected living criminals in the attempt to find the hidden springs of life. Buck says of them, "These two men evidently realized to the full how important it was to medicine, if it were to make a substantial advance beyond the point to which Hippocrates and his followers had already carried it, that a more complete understanding of the structure and working of the human body should be obtained". Herein lies the great superiority of the Alexandrian over the Greek schools—the former had conceived the basic importance of practical anatomy which the latter had missed so completely. If this spirit had been fostered, instead of the quiescent attitude which replaced it, the history of the Alexandrian school would have occupied many more volumes. As it was, the successors of Herophilus and Erisastratus were content to study what these two had discovered until the demolition of the school in the seventh century, which shall be mentioned again.

In the meantime, the city of Rome was the centre of another school of anatomy. The conditions leading up to its establishment are of no immediate concern. Passing over the transition of conditions in Rome from a primitive to a luxurious type, resulting in an increase of disease, and an immigration of physicians from Greece, there were no original investigators until one comes to Galen, A.D. 129. When one considers the stagnation in research at that time, great credit must be given to Galen for his extensive work in practical anatomy although he was not free from the reluctance to dissect human bodies which was prevalent in his day and for long after. Le Clerc, in his "Histoire de la Medicine" cites an incident that illustrates this. "The physician (Galen) was walking not far from the main road, when he came across

the dead body of a robber. The peasants of the district were not willing to bury the corpse of such a bad man, and accordingly they allowed it to remain at the spot where it was first discovered. In the course of the following two days, as might be expected, the vultures removed every particle of flesh from the bones, so that, when he saw what remained of the body, the only thing visible was a nicely cleaned skeleton." Here was an excellent opportunity to add to his information on the anatomy of man, but he was held back by a belief that such an act would constitute a sacrilege, hence he confined himself to an examination of the bones. Many of Galen's texts on anatomy are still extant, and they identify him as a skilful dissector, a careful observer, and a clear, forceful expressionist. The modern dissector, with his fine equipment, must be filled with admiration on reading this note of one of the observations on the pioneer dissector, hampered, as he was, by the restrictions of that time.

"He, (Galen) describes the optic nerve, the oculo-motorius and trochlearis, the different ramifications of the trigeminus, the acousticus and facialis, the vagus and glossopharyngeus, the nerves of the pharynx and larynx, the sympatheticus (with the accompanying ganglia), and the radial, ulnar, median, crural and ischiatic nerves." (Puschmann.)

Yet Galen shared in the faults of his day. Neuburg criticizes his work on two main grounds: the first, because it was based upon the dissection of animals only, the results being applied by analogy to man; the second because his investigations were not conducted impartially; his anatomy had to accommodate itself to physiological speculation.

These two fundamental faults, one might add, are identical with the chief errors committed by the early Greeks, away back in the fifth century, B.C., when the science was in its early stages. The stress which was placed upon the innate tendency of the Greeks to adapt the facts to suit their pre-formed theories will be recalled. In a lesser degree Galen inclined to the same mistake. The other fault of limiting dissection to animals was corrected by the later Greeks, but unfortunately it was a long time before it was rectified by those who came after Galen.

The feeble light first lit in the schools of Alexandria and Rome soon burned out, and for a period of twelve centuries medical science shared in that depression which marks the history of all branches of knowledge, during what has been so aptly named the "Dark Ages". The invasion of Rome by the Barbarians in the fifth century resulted in a tremendous destruction of medical literature and a scattering of the various schools. In the seventh century, Alexandria was captured by the Arabs, whose religion, Mohammedanism, forbade the dissection of human bodies. The complete dominance of this belief is shown by incidents attending a public lecture on anatomy in Alexandria in the nineteenth century, the first in 1700 years. When the lecturer, Clot Bey, first opened the thorax, a student rushed upon him and stabbed him with a poniard. The blade slid over the ribs. Perceiving that the wound was not serious, the lecturer took a piece of plaster from his dressing case, and, applying it to the wound, coolly remarked to the class, "We were speaking, gentlemen, of the disposition of the ribs and sternum, and I now have the opportunity of showing you how a blow directed from above has so little chance of penetrating the thorax", and he went calmly on with the lecture.

There was nothing further to record in the history of anatomy until the thirteenth century. Research was at a standstill in the intervening centuries. The following passage, noted in Moore's "Medicine in the British Isles", which typifies the work in medicine during the Middle Ages might be quoted:

"The libraries of monasteries and cathedrals always contained books on medicine, and, as reading was thought the chief source of medical knowledge, books were even more important to a physician in the Middle Ages than they are at the present day. The catalogue of the library of Chaucer's physician is familiar to everyone:

'Well knew he the olde Aesculapius,
And Deiscorides and eek Rufus,
Old Ypocras, Haly and Galien;
Seraphyon, Razis and Avycen;
Averroes, Damascien and Constantyn;
Bernard and Gatesden and Gilbertyn.'"

The revival of anatomy forms a part of the great renaissance in all branches of knowledge which took place in the sixteenth century. Mondino, an Italian anatomist, slightly anticipated the true revival when he dissected two bodies publicly in the thirteenth century, but the practice was discontinued. Leonardo da Vinci, the Italian artist, contributed some wonderful drawings of his dissections, in the fifteenth century. But the anatomist who is given the credit for overthrowing the Galenic tradition and establishing the fundamental principle of relying on observed facts for the construction of the science is Andrea Vesalius. His early instruction, as related by Buck, "consisted in interpretations of Galen's teachings, in dissections of a few animals, and in occasional demonstrations—which never lasted longer than three days—of the easily accessible parts of the human cadaver. In his eager cultivation of the science, he encountered facts which led him to suspect the inaccuracy of some of Galen's assertions, and in his "De corporis humani fabrica" of 1543, he pointed out some of these errors. Many anatomists refused even to test out his corrections, and there was a great deal of heated controversy before Vesalius had established his observations. His life ended in an unfortunate manner—he was shipwrecked in a voyage from Spain from which he had been exiled because of a charge of vivisection. It is interesting to note that a similar charge had been laid against the first dissectors, Herophilus and Erisastratus, at Alexandria, in the third century, B.C. It is impossible, in such a limited space, even to mention the work of the other anatomists of the sixteenth century. It must suffice to say that they corroborated and elaborated many of Vesalius' descriptions, as well as discovering new structures. Many of the latter are named after their discoverers, Fallopius, Eustachius, Columbus, Variolus, Fabricius and others.

It has been seen above how the predecessors of Vesalius had founded various schools, all of which gradually declined soon after the dominant personality of the founder was removed. But the work of Vesalius proved to be the foundation of a structure which has increased steadily ever since, by the efforts of many scientists in many nations.

It was fitting that Italy, the country which gave birth to the Humanist movement, should take the lead in the reconstruction of anatomical

science. In her universities, professorships in Anatomy were established early in the sixteenth century and so successful were they that students from all Europe were attracted by thousands. They returned to their own countries, eager to advance this new study. The result was that schools of anatomy were established in England, Scotland, Holland, Germany and France.

In England, Henry VIII granted the privilege of dissecting four dead criminals annually, to the Royal College of Surgeons, soon after it was founded in 1540. About twenty years later, Elizabeth granted the same privilege to the Royal College of Physicians. It was under the auspices of the latter college that Harvey gave his first public demonstrations of the circulation of the blood, in the following century.

In Scotland, the Edinburgh Act of 1505 had allowed of one annual dissection, but this was scarcely worthy of the name beginning. The first Scottish anatomical theatre was built and the first public demonstrations were given in 1697. Monro was the first regular professor, with the princely salary of £15 per annum! The Monros, father, son and grandson held this position until 1846, a period of one hundred and twenty six years.

Holland was next to England, chronologically, in the revival of anatomy. Ruysch, Swammerdam, Albinus and Boerhaave were the anatomical lights of Europe in the seventeenth century. Keens describes the anatomical museum of Ruysch in a most interesting way, elaborating his description with a variety of amusing anecdotes which make the account very readable indeed. The fame of this museum was such as to make it the admiration of all distinguished men at home and abroad. Generals, ambassadors, princes and even kings delighted to visit it and spend whole days with its author. Peter the Great visited Ruysch and waxed very enthusiastic over medical science and attended many of Ruysch's lectures. He even insisted on operating on a Dutch merchant's wife, not too successfully. She died. The Tsar attended the funeral, by way of consolation. The objects in the museum were labelled with suitable inscriptions: for example,—a still-born child's motto was "Haec mihi prima dies, haec mihi summa fuit"—"This my first day was my last", which Keens remarks, reminded him of the laconic motto in a similar case—

"If I was so soon to be done for,
What was I ever begun for?"

The dissections of Vesalius and his immediate successors, were confined to the grosser parts of the body. The bones, muscles and viscera were almost the only well-dissected and well-described parts. The limitations which necessitated this state of affairs were scarcity of cadavers, imperfect instruments, lack of a good process of injection, and of suitable preservatives.

The difficulty of obtaining a sufficient knowledge of anatomy without violating the feelings of the community had been felt since the dawn of the science. Vesalius, while yet a student under Sylvius, had to prowl around the places of execution and spoil the gallows of its victims, and, to retain his booty, was sometimes obliged to hide the bodies even in his own bed. The first legal source, as has been mentioned above, was from executed criminals. In 1726, the act was amended so that all such subjects were available for dissection and this was the state of affairs

until 1832. From 1805 to 1820, a yearly average of seventy-seven criminals were executed in Great Britain, and at the same time there were about one thousand medical students at London and nearly as many at Edinburgh. Seventy-seven bodies for two thousand students. How was the problem solved? There arose a class of men called resurrectionists—a set of villains who robbed the graveyards and sold their spoil to students and doctors. They became very numerous—in London alone they numbered over one hundred regulars and many occasionals, at one time. They were cunning, resourceful—no obstacle could be found to hinder them permanently. Their skill was such that Sir Astley Cooper, in his evidence before the Parliamentary Committee, said that he could obtain the body of any man in England, no matter how high his social position. The prices charged were tremendous—£16, £20, as high as £30, were paid for a single subject. One instance is told of the steps taken by John Hunter to secure the body of O'Brien, the Irish giant, whose skeleton measured 8 ft. 4 ins. The guardians of the coffin were bribed first for £50, then £100, and finally, they became so avaricious as to demand £500. This was agreed to, and the body was obtained.

But even worse conditions ensued. The resurrectionists became so debased that they did not halt even at murder. The case of William Burke, in Edinburgh, is a horrible example. After his conviction, he made a confession of all his many crimes. While he and his mistress, Helen McDougall, were lodging with a man named Hare, one of the lodgers died, owing Hare £4. They took the body to Dr. Knox, and sold it for £7 10*s*. Finding it so profitable, the three then proceeded to smother every available lodger who fell into their hands, and in the year that elapsed before their detection, sixteen persons had been murdered. Burke was executed January 28th, 1829, and, by order of the judge, was publicly dissected. His skeleton is in the Anatomical Museum of the University of Edinburgh, and from his tanned skin, John Arthur, afterwards janitor to Prof. John Goodsir, had made a tobacco pouch, which he carried for many years as a memento of the period when he first became connected with the dissecting room.

Conditions had reached a climax. The need for a proper supply of cadavers had been forced on public attention. In 1832, the Warburton Bill was passed, giving all unclaimed bodies to the various schools. All subsequent acts, including our own, have been modelled after it.

Passing now to the handicap of unsuitable instruments, mention might be made of Rembrandt's painting in the Hague, about 200 years old, representing Van Tulp demonstrating the muscles with an ordinary surgical dressing forceps. This awkward substitute for the modern dissecting forceps, together with a pair of double hooks on a handle, and the fingers were then the anatomist's only resources. Yet, it was with such clumsy instruments as these that Vidius traced his perplexing "Vidian nerve". A comparison with the instruments in modern laboratories will suffice to show what advances have been made—except, of course, that the student of to-day must rely upon his fingers, as every dissector knows.

The first attempts at injecting were made by Carpi, Etiennes and Eustachius, in the sixteenth century, and Malpighi, Glisson and Willis, in the seventeenth, who used air, water, milk, ink and other coloured

fluids to trace the vessels. It was by injecting the brain with "aqua crocata" that Willis discovered the "Circle of Willis". In Holland, however, the first substantial progress was made. De Graat, about 1668, injected mercury into the spinal vessels. Swammerdam, Ruysch and Albinus, however, really created and diffused the knowledge of the art of injections. Swammerdam saw that in order to fulfil its purpose the material used ought to be injected as a fluid and yet solidify in the vessels, not evaporating as water did. He first used suet, and then wax. Ruysch has been mentioned and his famous museum. A fellow countryman, Leeuwenhoek, had just made available at this time, a microscope, by means of which Ruysch was able to inject fine vessels directly and also to discover networks of vessels, hitherto unsuspected. His work in embalming infants is said to have been so successful that Peter the Great kissed one of the children that he had treated. A very ingenious method is generally accredited to Nicholls of Oxford. He injected the vessels with wax or metal, allowed it to harden and then removed the animal textures, by corroding or maceration, thus leaving a perfect cast of the vessels. The many methods and materials devised ever since have proved an invaluable aid in anatomical and microscopical research.

There was another handicap to dissection in the revival period: lack of preservatives. It is obvious that great haste was necessary to complete the work before decomposition had progressed too far. For instance, Mandini, the first of the revivalists, completed the anatomy, physiology and surgery of the entire body in five lectures.

The good results which Ruysch obtained in embalming have been mentioned. One of his contemporaries, De Bilsius, also was reported to have obtained extraordinary results in the art. However the success of both these men was probably exaggerated as the bodies which they later pretended to embalm for the University of Louvain were soon destroyed, and, apparently, in proof of the inefficiency of the method of De Bilsius, so foul was the air of the rooms in which he prepared his subjects, that it was said to have been the cause of the consumption to which he fell a victim.

The largest collection of bodies preserved by the simplest artificial method, namely, that of desiccation by means of artificial heat, is in the monastery of the Capuchians near Palermo. All its inmates who have died for the last two hundred and fifty years, more than two thousand in number, stand upright in ghostly companionship, in the niches of its subterranean galleries.

Other means, however, were needed in dissection. For practical anatomy, the first method which rendered patient and prolonged dissection possible, was the use of alcohol. Since then, chemistry has added largely to the means for this purpose, such as chloride of zinc, arsenic, salt and nitre, hyposulphite of soda, acetate of aluminium, hydrate of chloral, etc.

It will be seen that obstacles in the path of progress, in this, as in all branches of human endeavour, were removed by self-sacrificing diligence on the part of the anatomists who have gone before, and that the perplexing problems of to-day are being solved in just the same way. Herophilus dissected over 600 bodies; Berengarius of Carpi, the contemporary of Vesalius, dissected over one hundred; Haller dissected more than 400 in 17 years, while John Hunter, at the trial of Captain

Donellan, in 1781, in answer to a question, replied, "In the last 33 years, I have dissected some thousands of bodies".

And Keens says, "To-day, after considerable personal experience as a teacher of anatomy, I have grave doubts whether the majority of our students dissect the human body more than once!"

NOTES AND COMMENTS

Queens' At Home Mr. James McFadden of 2T5 was Toronto's representative to the At Home given by the Aesculapian Society of Queens University. He reports that even their Rugby is surpassed by the hospitality of their Medical Students.

Medical Office Staff We are very fortunate in having Miss Russel, Miss Jones and Miss Perry on the staff in the Medical Office. The undergraduates endeavoured in a small way to show their appreciation of their many kindnesses by presenting them at Christmas with a reading lamp for their rest room in the Medical building.

Appointments Mr. Cobe Campbell of 2T7 has been appointed to succeed Mr. H. E. Bicknell as business manager of the MEDICAL JOURNAL. Mr. Bicknell felt that as he was Director of the Medical Orchestra he did not have time to spend on the two positions and at the same time carry on his other work. Mr. Bicknell has very capably blazed the trail and we regret that he has felt compelled to resign. We feel sure the business side of the JOURNAL will not suffer in Mr. Campbell's hands.

Medical Meeting A Junior Open Meeting and Smoker was held in Hart House lecture room on November 28th. Dr. Elliott of St. Michael's Hospital gave an illustrated lecture on the life of Jenner. The Second Year orchestra rendered very good music. Refreshments were served following the meeting.

Medical At Home The Medical Society Annual At Home will take place at the King Edward Hotel on Friday, February 1st, 1924. Subscription lists are to be passed out to the various years in the Faculty and allotment of tickets will be made from these lists. The committee in charge of arrangements are: R. C. Montgomery 2T4, Chairman; J. McFadden 2T5, Secretary; C. R. Weber 2T6; R. J. Heffering 2T7; E. M. McMurray 2T8, and W. A. McTavish 2T9.